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# Addenda to Allied Medical Publication 8, "NATO Planning Guide for the Estimation of Chemical, Biological, Radiological, and Nuclear (CBRN) Casualties" *(AMedP-8(C))* to Consider the Impact of Medical Treatment on Casualty Estimation

Carl A. Curling, Project Leader
Julia K. Burr
Lucas A. LaViolet
Preston J. Lee
Kristen A. Bishop

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INSTITUTE FOR DEFENSE ANALYSES
4850 Mark Center Drive
Alexandria, Virginia 22311-1882

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# Executive Summary

The North Atlantic Treaty Organization (NATO) *Allied Medical Publication 8, NATO Planning Guide for the Estimation of CBRN Casualties* (referred to in this document as *AMedP-8(C)*), describes a methodology for estimating casualties resulting from chemical, biological, radiological, or nuclear (CBRN) attacks on military populations. In anticipation of a future expansion of the scope of *AMedP-8(C)*, the Institute for Defense Analyses (IDA) has recently revised the methodology to account for care provided to patients entering the medical system. The parameters developed to incorporate the effect of medical intervention are published in IDA Document D-4465, *The Impact of Medical Care on Casualty Estimates from Battlefield Exposure to Chemical, Biological and Radiological Agents and Nuclear Weapon Effects*.[1]

Incorporating medical care parameters into *AMedP-8(C)* will require substantial changes to several of its chapters as well as three of its annexes. This document presents the text, tables, and figures that will need to be added to *AMedP-8(C)* if medical care is integrated. Each chapter of this document contains the addenda to one chapter or annex in *AMedP-8(C)*, and sections are written to be consistent with the contents of the existing publication.

[1] Carl A. Curling et al., *The Impact of Medical Care on Casualty Estimates from Battlefield Exposure to Chemical, Biological and Radiological Agents and Nuclear Weapon Effects*, IDA Document D-4465 (Alexandria, VA: Institute for Defense Analyses, December 2011).

# Contents

# Appendices

# 1. Introduction

The North Atlantic Treaty Organization (NATO) *Allied Medical Publication 8, NATO Planning Guide for the Estimation of CBRN Casualties* (referred to in this document as *AMedP-8(C)*), describes a methodology for estimating casualties resulting from chemical, biological, radiological, or nuclear (CBRN) attacks on military populations. In anticipation of the future expansion of the scope of *AMedP-8(C)*, the Institute for Defense Analyses (IDA) recently revised the methodology to account for care provided to patients entering the medical system. The parameters developed to incorporate the effect of medical intervention are published in IDA Document D-4465, *The Impact of Medical Care on Casualty Estimates from Battlefield Exposure to Chemical, Biological and Radiological Agents and Nuclear Weapon Effects*.[1]

The objective of this addendum to *AMedP-8(C)* is to present the text, tables, and figures that must be added to account for the impact of medical care on casualty estimates. It includes the addition of medical care assumptions to *AMedP-8(C)* Chapter 1, survivor and non-survivor estimation descriptions to *AMedP-8(C)* Chapter 3,wounded in action (WIA) and died of wounds (DOW) calculation instructions to *AMedP-8(C)* Chapter 4, the infectivity and lethality submodel parameters and the tables derived for estimating WIAs and DOWs by day to *AMedP-8(C)* Annex A, and finally the parameters with accompanying figures and tables for the remaining submodels to *AMedP-8(C)* Annex C. To simplify the process of incorporating these sections into *AMedP-8(C)*, their content and format are consistent with the current chapters of that guide.

The 2010 version of this document, IDA Document D-4133, *Addenda to Allied Medical Publication 8, "NATO Planning Guide for the Estimation of Chemical, Biological, Radiological, and Nuclear (CBRN) Casualties" (AMedP-8(C))—Parameters for Estimation of Casualties from Exposure to Specified Biological Agents*, provided substantial modifications to the content of *AMedP-8(C)* that would be needed to incorporate human response models for five biological agents not originally considered in *AMedP-8(C)*: brucellosis, glanders, Q fever, staphylococcal enterotoxin B (SEB), and tularemia. This document retains and builds upon the 2010 version, so that the prospective modifications to *AMedP-8(C)* are captured in their entirety in a single publication. Several editorial changes, such as renumbering figures and tables, updating the corresponding references in the text, and adding the appropriate new symbols to the list in Annex D, will also be required to account for both the increased number of agents and the consideration of medical care. Although it is important that these minor adjustments are made to *AMedP-8(C)*

[1] Carl A. Curling et al., *The Impact of Medical Care on Casualty Estimates from Battlefield Exposure to Chemical, Biological and Radiological Agents and Nuclear Weapon Effects*, IDA Document D-4465 (Alexandria, VA: Institute for Defense Analyses, December 2011).

to make it comprehensible and internally consistent, they are not the focus of this effort and will not be captured in this document.

# 2. *AMedP-8(C)* Chapter 1 Addenda

This chapter presents the addenda to *AMedP-8(C)* Chapter 1: the deletions, modifications, and additions needed to account for consideration of medical care. It also includes addenda provided in the 2010 version of this document for consideration of specific additional biological agents.

## A. Scope (Section 0103)

### 1. Modifications

The scope has been expanded to include five additional biological agents. Paragraph 0103.1b should be modified to read:

b. Biological agents include the causative agents of anthrax, brucellosis, glanders, Q fever, tularemia, staphylococcal enterotoxin B (SEB), Venezuelan Equine Encephalitis (VEE), plague, and smallpox. In addition, although sometimes considered a chemical agent, botulinum neurotoxin will be treated as a biological agent for the purposes of this document. Anthrax, botulism, brucellosis, glanders, Q fever, SEB, and VEE will be considered non-contagious diseases, while plague and smallpox will be treated as contagious diseases.

## B. Definitions (Section 0104)

### 1. Additions

As part of the consideration of medical treatment, the *AMedP-8(C)* methodology can now be used to estimate casualties in two additional categories: return to duty (RTD) and convalescent. Definitions for these terms should be added as paragraph 0105.8:

8. Users of this document can choose whether or not estimated human response to CBRN agents and effects considers the effects of medical care. When medical care is considered, the associated injury profiles model the progression of injury through recovery. Two additional casualty categories can be estimated, as described below.

a. An individual returned to duty (RTD) is "released from medical care to their unit."[2] These individuals are assumed to recover from their injuries sufficiently to allow resumption of normal duties.

[2] NATO, *AMedP-13*, 20.

b. An individual who is Convalescent is assumed to survive their CBRN injury but require medical care for extended periods of time, beyond the acute phases of injury considered in this document.

## C. Overview of Methodology (Section 0105)

### 1. Modifications

With the consideration of medical care, paragraph 0105.4 should be changed to read:

4. As per AJP-4.10, Allied Joint Medical Planning Doctrine, the final step in the casualty estimation methodology results in four outputs: population at risk (PAR), rates, profile, and flow. PAR is simply the total number of troops included in the scenario characterization. Rates provide the number of new casualties (KIA, WIA, DOW, RTD, and Convalescent) per 100 of the PAR each day. The profile demonstrates how the number of new casualties changes over time. Finally, the flow characterizes the movement between casualty categories (e.g., from WIA to DOW).

## D. Assumptions and Limitations (Section 0106)

### 1. Deletions

The following assumptions from Section 0106.2 (pages 1-6 and 1-7) need to be deleted since medical care is now included:

b. For most CBRN agents and effects, the methodology does not model medical countermeasures...

c. At the present time, the methodology does not include medical treatment…

d. The methodology does not estimate the number of individuals who recover or the time at which they would do so….

### 2. Modifications

In addition, the general biological agent assumption (0106.7a(6)) needs to be modified:

(6) Users of this methodology can elect to include or exclude consideration of prophylaxis where available. Prophylaxis (either pre-exposure vaccination or post-exposure, pre-symptom onset antibiotic prophylaxis) is assumed to be efficacious for a percentage of the population, independent of dose; there is no defeat dose beyond which the prophylaxis fails to be effective. This assumption may tend to underestimate casualties in scenarios involving very high doses of agents.

## 3. Additions

There are several non-contagious biological agent assumptions and limitations that need to be added. The first assumptions, which apply generally to all biological agents, should be added to Section 0106.7a, following paragraph 0106.7a(6).

(7) The methodology assumes that when human data are not available, human response parameters can be derived from animal models. Non-human primates are the animal model of choice unless otherwise stated.

(8) To simplify the model, a case fatality rate of 1% or below is considered negligible and a fatality rate of 0% is assumed. Similarly, in the absence of a well-quantified fatality rate, 100% lethality is assumed based on qualitative descriptions such as “highly lethal without treatment” or “nearly always fatal.”

The remaining paragraphs in this chapter describe the agent-specific assumptions and limitations for the new agents and should be added to the non-contagious biological agent explanation in Section 0106.7b, following the Venezuelan equine encephalitis (VEE) assumptions and limitations discussed in paragraph 0106.7b(3)(b).

(4) Brucellosis assumptions and limitations.

(a) Available case data from patients infected with different species of *Brucella* (*B. abortus, B. melitensis,* and *B. suis*) are similar enough that the human response is assumed to be the same following exposure to any of these species.

(b) The presentation and duration of brucellosis symptoms are assumed to be independent of the route of exposure. This assumption allows for the inclusion of a much larger body of data from which to characterize the injury profile and duration of illness submodels.

(c) In order to combine data reported in different units, one organism, one cell, and one colony forming unit (CFU) are assumed to be equivalent units.

(5) Glanders assumptions and limitations. Due to a lack of data from inhalation cases, the methodology assumes that the human response to *Burkholderia mallei* is independent of the route of exposure. Since aerosol exposures would likely result in symptoms that manifest earlier than those resulting from other routes of exposure, this assumption may result in a delayed reporting of casualties. In addition, this assumption may underestimate the number of fatalities, as inhalation glanders is thought to be more lethal than other forms.

(6) SEB assumptions and limitations.

(a) Consistent with the assumptions made for chemical agents, the methodology assumes SEB exposure to a 70 kg man. Since SEB intoxication is modeled for inhalation of a biotoxin, then (just as for chemical agents) this assumption may lead to an over- or underestimate of the number and severity of casualties.

(b) In the absence of lethal dose response data, the probit slope for SEB lethality was assumed to equal the probit slope for effectivity.

(7) Tularemia assumptions and limitations. Inhalation of *Francisella tularensis* is assumed to result in the pneumonic form of tularemia. Some of the most comprehensive clinical studies of tularemia available were reported in the pre-antibiotic era before inhalation was understood to be a potential route of infection; since pneumonic tularemia has been attributed to inhalation of the agent, untreated cases have been rare. Therefore, historical cases of typhoidal tularemia with pneumonia are assumed to provide the best available data to characterize lethality, injury profile, and duration of illness within the tularemia human response model.

## E. Document Organization and Use

### 1. Modifications

With the addition of RTD/Convalescent as a casualty category, the methodology overview figure provided in each chapter of the main body of *AMedP-8(C)* needs to be modified to show this as an output. Figures 1-1, 2-1, 3-1, and 4-1 should be replaced with Figure 1, below, with shading appropriate to each chapter.

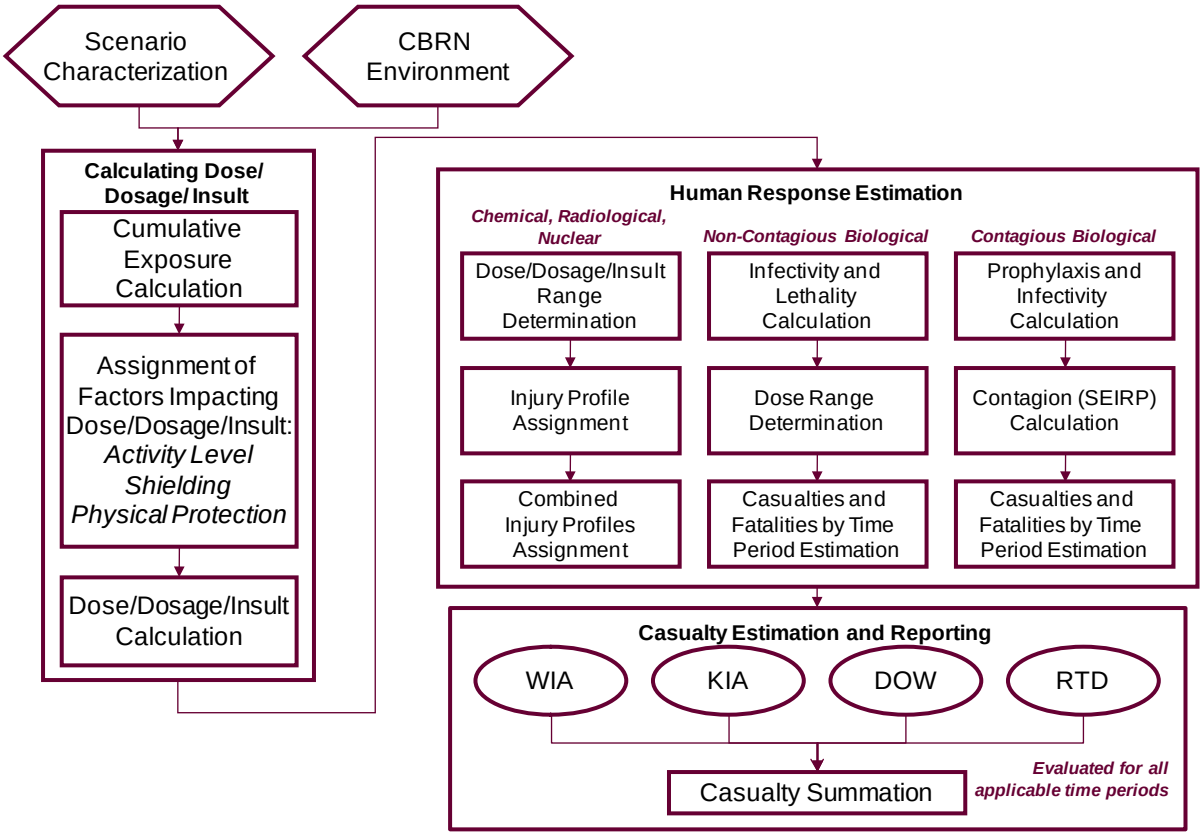


**Figure 1. AMedP-8(C) Methodology Overview**

# 3. *AMedP-8(C)* Chapter 3 Addenda

This chapter presents the addenda to *AMedP-8(C)* Chapter 3: the deletions, modifications, and additions needed to account for consideration of medical care. It also includes addenda provided in the 2010 version of this document for consideration of specific additional biological agents.

## A. Chemical, Radiological, and Nuclear (CRN) Human Response Component (Section 0302)

### 1. Additions

Consideration of medical care for CRN agents and effects requires either changes to the methodology's input data, or manipulation of the methodology's output injury profile. The following description of this process should be added as paragraph 0302.1e:

e. Consideration of medical care. For any given CRN agent or effect, consideration of medical care may affect any of the components of the human response methodology. Prophylaxis and pretreatments, if available, may change the dose/dosage/insult ranges associated with different clinical effects of interest. Treatment will change the duration and severity of injury; these changes may be implemented as changes to the underlying injury profiles or as modifications to the outputs of the casualty estimation and reporting process described in Chapter 4.

## B. Biological Human Response Component (Section 0303)

### 1. Modifications

The second sentence of paragraph 0303.2c(1) should be modified as follows:

"In the absence of medical care, anthrax is expected to be lethal in all cases."

Section 0303.3d should be modified as follows:

*Line out:* $p_f(d_n)$ is the probability of fatality (for contagious agents, this value is independent of dose, so $p_f(d_n) = p_f$).

*Line in:* $p_f$ is the probability of fatality given illness (i.e., the case fatality rate).

Paragraph 0303.3h(1)(b) should be modified to read:

(b) Without treatment, the probability of death is assumed to be 100% if exposed and infected with pneumonic plague. In this case, $R(t) = R_f(t)$ and $R_m(t) = 0$. With treatment, the probability of death is assumed to be 0% if treatment is initiated within 24 hours of the onset of symptoms, and 100% if treatment is initiated at a later point. Within the contagious biological human response component, all individuals exposed and infected with pneumonic plague who undergo treatment are considered removed from the infectious population and are assumed to enter the $R_m(t)$ cohort at the time they become WIA. The effects of treatment on the subsequent allocation of these individuals to DOW and RTD casualty categories at various points in time are estimated outside of the SEIRP model.

## 2. Additions

Consideration of medical care for biological agents and effects will result in changes to one or more of the submodels used to characterize human response. The following description of this process should be added as paragraph 0303.1e:

e. For any given biological agent, consideration of medical care may affect any of the submodels characterizing aspects of human response. Prophylaxis may reduce or eliminate the probability that an individual will become ill, reduce or eliminate mortality, result in milder forms of illness, or speed recovery. Treatment can reduce mortality, mitigate the severity of injury, or shorten the duration of illness.

The following paragraphs describe the agent-specific considerations for implementation of the general non-contagious biological human response approach and should be added to Section 0303.2c, following the VEE considerations discussed in paragraph 0303.2c(3).

(4) Brucellosis. Brucellosis is not modeled to be lethal in any case; therefore, E = S. Since F = 0, the brucellosis tables in Annex A do not consider fatalities. Because the disease manifests with an abrupt onset in approximately half of the cases and an insidious onset in the other half,[3] the methodology requires that the total number of persons who become ill (E) be split into two groups. One table in Annex A is used to calculate the daily rates of casualties for the 50% experiencing abrupt onset and another table is used for the 50% experiencing insidious onset.

(5) Glanders. Glanders is expected to result in both fatalities and survivors. Although there are separate injury profiles for the two groups, the profiles are the same through Stage 3 (the most severe stage of disease), after which the survivors enter a chronic illness stage and the non-survivors die. Since the two profiles differ only after the highest severity is reached, only the

[3] Insidious onset disease develops slowly, with symptoms gradually progressing in number and severity. See Edward J. Young, "Human Brucellosis,"*Reviews of Infectious Diseases* 5, no. 5 (1983): 821–42; Edward J. Young, "An Overview of Human Brucellosis,"*Clinical Infectious Diseases* 21, no. 2 (1995): 283–89; and P. Bossi et al., "Bichat Guidelines for the Clinical Management of Brucellosis and Bioterrorism-Related Brucellosis," *Eurosurveillance* 9, no. 12 (2004): 1–5.

total numbers of illnesses (E) and fatalities (F) are needed to calculate the rate of casualties by day, as described in Chapter 4.

(6) Q fever. Q fever is not modeled to be lethal in any case; therefore, E = S. Since F = 0, the Q fever tables in Annex A do not consider fatalities. Because the incubation period model selected for Q fever is dose-dependent, the estimated number of persons who become ill must first be binned according to the dose received to determine the number of casualties by day. This calculation is made for each dose range specified in Table A-58 by summing $E_n$, the number of people ill at Icon *n*, for all icons receiving doses in that range.

(7) SEB. SEB is expected to result in both fatalities and survivors. Since the injury profiles for SEB survivors and non-survivors both reach their maximum severity level during the first stage of illness and the two groups share a common incubation period, the total number of people ill (E) is sufficient to calculate the number of people ill by day as described in Chapter 4. To determine the number of fatalities by day, however, the total number of fatalities (F) must be binned by the received dose into the dose ranges specified in Table A-62. For each dose range, users must sum $F_n$, the number of fatalities at Icon *n*, for all icons receiving doses in that range.

(8) Tularemia. Tularemia is expected to result in both fatalities and survivors. Like Q fever, the incubation period model for tularemia is dependent on dose, so both the estimated number of people ill (E) and the estimated number of fatalities (F) must be binned according to the dose ranges specified in Tables A-65 and A-66. Thus to determine the number of people ill within a dose range, users must sum $E_n$ for all icons receiving doses in that range. Likewise, to determine the number of fatalities for a given dose range, users must sum $F_n$ for all icons receiving doses in that range.

# 4. *AMedP-8(C)* Chapter 4 Addenda

The addenda to *AMedP-8(C)* Chapter 4 include additions or modifications to the process of calculating the number of casualties by type per day.

## A. Introduction to Casualty Estimation (Section 0401)

### 1. Modifications

The second-to-last sentence in this paragraph should be modified to read:

This final chapter will address how to use the outputs of the human response estimation component to determine casualty status as categorized by KIA, WIA, DOW, and RTD/Convalescent and how to compile the resulting casualty estimates in a manner useful to the planner.

## B. Characterization of Chemical, Biological, Radiological, and Nuclear (CBRN) Casualties (Section 0402)

### 1. Modifications

The third sentence of paragraph 0402.1 should be changed to read:

Rates provide the number of new casualties (KIA, WIA, DOW, and RTD/Convalescent) per 100 of the PAR each day.

The second sentence of paragraph 0402.2 should be changed to read:

Rather than simply designating CBRN casualties as KIA, WIA, DOW, or RTD/Convalescent, additional information can be provided to allow for the consideration of the special characteristics of the CBRN casualty.

## C. Summation and Reporting (Section 0403)

### 1. Modifications

Paragraph 0403.1 should be replaced with the following:

1. The final step in the casualty estimation process is reporting the casualty estimate. AJP-4.10 requires that the different components to the casualty estimate, KIA, WIA, DOW, and

RTD/Convalescent be reported as rates (number of casualties/100/day) relative to the population at risk (PAR). To calculate this value, the total number of new casualties each day is divided by the PAR and multiplied by 100. Table 4-1 provides a template for presenting the casualty estimate. This table is intended to show rates for individuals meeting the casualty criterion of WIA (1) (Severity Level 1 ("Mild") or greater), and further, to categorize the rates by the severity level of individuals at the time at which they become casualties.

Table 4-1 should be replaced with the following table, which is formatted to include estimated rates of RTD/Convalescent.

**Table 1. Estimated Casualty Rates for Notional CBRN Attack (per 100 per day) (PAR = 1,000)**

| | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Day 15 | Day 30 | Day 60 | Day 90 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Prompt Fatalities (KIA) | | | | | | | | | | | |
| Delayed Fatalities (DOW) | | | | | | | | | | | |
| Total Fatalities | | | | | | | | | | | |
| Mild Casualties (Severity Level 1) | | | | | | | | | | | |
| Moderate Casualties (Severity Level 2) | | | | | | | | | | | |
| Severe Casualties (Severity Level 3) | | | | | | | | | | | |
| Very Severe Casualties (Severity Level 4) | | | | | | | | | | | |
| Total Casualties (WIA(1)) | | | | | | | | | | | |
| Convalescent | | | | | | | | | | | |
| Return to Duty | | | | | | | | | | | |

## D. CRN Casualty Estimation (Section 0404)

### 1. Modifications

Paragraph 0404.1 should be modified to read:

1. In general terms, the CRN casualty estimation process relies on the use of the composite injury profiles; their development was described in Chapter 3. A description of how to determine KIA, WIA, DOW, and RTD/Convalescent status from these profiles will be followed by an example and a discussion of special considerations and exceptions as applicable to specific agents and effects.

Paragraph 0404.5 should be modified to read:

5. With these operational definitions of KIA, WIA, DOW, and RTD/Convalescent in place, the general casualty estimation process can begin. As already described in Chapter 3, the overall process for applying this model begins with the dose/dosage/insult inputs, the assignment of dose/dosage/insult range, referencing the appropriate injury profiles, and constructing the relevant composite injury profiles. A time-step iterative process is then performed that begins by checking whether the individuals within an icon can be classified as KIAs. If not, the WIA

criterion is checked to see if and when they become WIAs. If medical care is not considered, individuals who become WIAs are subsequently checked against the DOW criterion provided in Annex A to see if and when they can be classified as DOWs. If medical care is considered, the assignment of individuals to DOW and RTD/Convalescent categories is similarly made according to the criteria provided in Annex A.

Paragraphs 0404.11.c(3) and 0404.11.c(4) should be indented one level, so they are subordinate to paragraph 0404.11.c(2). Their appropriate markings should now be 0404.11.c(3)(a) and 0404.11.c(3)(b), respectively.

**2. Additions**

For completeness, an operational definition of RTD/Convalescent must be provided in Section 0404. The following paragraph should be added after paragraph 0404.4:

5. Return to Duty. When medical care is considered, an individual can be returned to his unit when he has recovered sufficiently to resume normal duties and when continuing medical observation is no longer warranted. Individuals who survive CBRN injuries but cannot resume normal duties or require ongoing observation do not return to duty but instead are considered convalescent. The assignment of individuals to RTD and Convalescent casualty categories depends on the expected progression of injury with medical care. This methodology does not consider the impact of theater evacuation policy on RTD. It should be noted, however, that individuals whose full recovery is expected but incomplete prior to evacuation out of theater may not return to duty immediately upon release from medical care.

Combined nuclear injuries involving whole body radiation plus blast or burn injuries are known to be more likely to result in death than the injury profiles currently estimate. To account for the impact of combined injury, the following paragraph should be added as the last paragraph in Section 0404 (now paragraph 0404.11.c(3)):

(3) For nuclear events, the prognoses for injuries that combine whole body radiation injury with burns and/or trauma are worse than for either type of injury in isolation. Potentially survivable burns and trauma will be fatal in a large percentage of persons who have also received sublethal doses of radiation. This methodology assumes that individuals exposed to doses of whole body radiation in excess of 2 Gy and with burn or trauma injuries of Severity Level 2 or higher will DOW at 10 days, unless otherwise expected to die earlier based on their injury profile. Likewise, individuals exposed to doses of whole body radiation in excess of 1.25 Gy and burn or trauma injuries of Severity Level 3 will DOW at six weeks, unless otherwise expected to die earlier.

## E. Non-contagious Biological Casualty Estimation (Section 0405)

### 1. Additions

The following paragraphs should be added to Section 0405.4, following the VEE discussion in paragraph 0405.4c.

d. Brucellosis.

(1) WIA. As shown in Table A-47, abrupt onset brucellosis is modeled as a single stage disease with a "Severe" symptom severity level. Whether the WIA criterion is defined at the "Mild," "Moderate," or "Severe" severity level, the number of abrupt onset WIAs per day is obtained by multiplying the total number of persons experiencing abrupt onset by the values in Table A-49. Insidious onset brucellosis, on the other hand, is modeled as a two stage disease with increasing severity over time. Once users select the severity level that characterizes an individual as a casualty, Table A-48 is used to determine which stage of disease first meets or exceeds the chosen severity level for insidious onset brucellosis. The number of WIAs per day is calculated by multiplying the number of persons experiencing insidious onset by the values in either Table A-50 (if the WIA criterion is "Mild") or Table A-51 (if the WIA criterion is "Moderate" or "Severe"). The total number of WIAs per day is calculated by adding the daily estimates of WIAs resulting from both abrupt and insidious onset brucellosis cases.

(2) DOW. Brucellosis is assumed to result in no fatalities. Therefore no DOW estimate is made and no additional calculations are required.

e. Glanders.

(1) WIA. Once users select the severity level that characterizes an individual as a casualty, Table A-52 is used to determine which stage of disease first meets or exceeds the chosen severity level. The total number of persons who become ill (E) is then multiplied by the fractional value for each day in the appropriate table in Annex A (Table A-53 if the WIA criterion is "Mild," Table A-54 if the WIA criterion is "Moderate," or Table A-55 if the WIA criterion is "Severe") to determine the number of WIAs per day.

(2) DOW. The number of glanders fatalities per day is calculated by multiplying the estimated total number of non-survivors (F) by each day's value in Table A-56.

f. Q fever.

(1) WIA. As shown in Table A-57, Q fever is modeled as a one stage disease with a "Moderate" symptom severity level. If users select a severity level of "Severe" as the casualty criterion, then no one will meet that criterion and there will be no estimated WIAs. Alternatively, if the casualty criterion is chosen as "Mild" or "Moderate," then the number of WIAs per day is calculated using Table A-58. Since the incubation period is a deterministic dose-dependent model, Table A-58 contains dose ranges rather than fractions of the population that become WIA on each day. No computation is needed beyond binning people into the dose ranges specified in

Table A-58; the number of people in each dose range is equal to the number of WIAs occurring on the corresponding day in the first column.

(2) DOW. Q fever is assumed to result in no fatalities. Therefore, no DOW estimate is made and no additional calculations are required.

g. SEB.

(1) WIA. As shown in Tables A-59 and A-60, the SEB survivor and non-survivor injury profiles both start with a symptom severity level of "Severe." Therefore, regardless of the casualty criterion, all individuals will be recorded as WIAs when they enter the first stage of illness. Since the incubation period is modeled to be the same for all people (nine hours), the total number of people (E) will be counted as WIAs on the day of the exposure, as indicated in Table A-61.

(2) DOW. Due to the dose-dependent model for the duration of illness, the time to death is a function of the dose of SEB inhaled. Once the estimated fatalities have been binned into the appropriate dose range in Table A-62, the number of people in each range is equal to the number of DOWs occurring on the corresponding day in the table's first column.

h. Tularemia.

(1) WIA. As shown in Tables A-63 and A-64, the tularemia survivor and non-survivor injury profiles both start with a symptom severity level of "Severe." Therefore, regardless of the casualty criterion, all individuals will be recorded as WIAs when they enter the first stage of illness. Since the incubation period is a deterministic dose-dependent model, Table A-65 contains dose ranges rather than fractions of the population that become WIA on each day. No computation is needed beyond binning people into the dose ranges specified in Table A-65; the number of people in each dose range is equal to the number of WIAs occurring on the corresponding day in the first column.

(2) DOW. Likewise, the number of fatalities per day is a function of the doses received by all individuals. Once the estimated fatalities have been binned into the appropriate dose range in Table A-66, the number of people in each range is equal to the number of DOWs occurring on the corresponding day in the table's first column.

## F. Contagious Biological Casualty Estimation (Section 0406)

### 1. Additions

The following text should be added as paragraph 0406.4:

4. Return to Duty/Convalescent

a. When treatment is considered for contagious biological agents, individuals are assumed to be removed from the exposed and infectious cohort when they become WIA and enter the medical system. Because they are receiving care within the medical system, these individuals are

assumed to no longer be infectious; thus the total number of WIAs is equal to the $R_m(t)$ cohort, and each day the number of new WIAs, ($I_{1,new}(t)$ or $I_{2,new}(t)$), is equal to $R_{m,new}(t)$.

b. Members of the $R_m(t)$ cohort are subsequently allocated to the DOW or RTD/convalescent casualty categories using the methodology for estimating non-contagious biological casualties. These allocations are calculated outside of the SEIRP model. Members of the $R_m(t)$ cohort who become DOWs are added to the $R_f(t)$ cohort as well.

# 5. *AMedP-8(C)* Annex A Addenda

This chapter presents the addenda to *AMedP-8(C)* Annex A. It includes both those addenda associated with the five new biological agents considered in the 2010 version of this document, as well as those needed to allow consideration of medical care.

For many biological agent-induced diseases, no medical countermeasures or specific treatments exist; the submodels now used in *AMedP-8(C)* to describe human response to these agents would not change with consideration of medical care. In these cases, existing duration of illness and injury profile submodels are used to estimate return to duty and convalescence.

## A. Chemical Injury Profiles (Section A105)

### 1. Additions

The new sections 105.4 and 105.8, below, describe the impact of medical care on chemical casualty estimates, and should be inserted into Section A105 following the nerve agent injury profile tables and figures and HD injury profiles and tables, respectively. Sections A105.4, A105.5, and A105.6 should be renumbered accordingly.

#### a. A105.4 Nerve Agent Medical Care Parameters

The untreated nerve agent injury profiles provided in sections A105.1 through A105.3 were developed by describing the symptoms within distinct physiological systems, then combining them to represent the whole-body response. When considering the impact of medical care, these injury profiles are used to determine the number of casualties and the time at which they become WIA. Subsequently, the number and timing of casualties who recover, die, or enter convalescent care are determined using the parameters provided in Table A-xx, below. The basis for these parameters is provided in Section C109.

**Table 2. Nerve Agent Medical Care Parameters**

| Inhaled GB Dosage Range (mg-min/m$^3$) | Inhaled VX Dosage Range (mg-min/m$^3$) | Percutaneous VX Dose Range (mg/man) | Casualty Criteria | | | |
|---|---|---|---|---|---|---|
| | | | WIA | DOW | RTD | Convales-cent |
| 0–0.2 | 0–0.02 | 0–0.8 | 0% | 0% | 0% | 0% |
| 0.2–6.5 | 0.02–2 | | If criterion met: 100% | 0% | Day 1: 100% | 0% |
| 6.5–12 | 2–4 | 0.8–1.6 | If criterion met: 100% | 0% | Day 2: 100% | 0% |
| 12–25 | 4–10 | 1.6–3.9 | 100% | 0% | For WIA(2) or WIA(3): Day 2: 33.3% Day 3: 33.3% Day 4: 33.3% For WIA(1): Day 4: 33.3% Day 5: 33.3% Day 6: 33.3% | 0% |
| 25–600 | 10–260 | 3.9–78 | 100% | 0% | 0% | 100% |
| >600 | >260 | >78 | 100% | Day 14:100% | 0% | 0% |

### b. A105.8 HD Medical Care Parameters

The untreated HD injury profiles provided in sections A105.5 through A105.7 were developed by describing the symptoms within distinct physiological systems, then combining them to represent the whole-body response. When considering the impact of medical care, these injury profiles are used to determine the number of casualties and the time at which they become WIA. Subsequently, the number and timing of casualties who recover, die, or enter convalescent care are determined using the parameters provided in Table A-xx, below. The basis for these parameters is provided in Section C114.

**Table 3. HD Medical Care Parameters**

| HD Dosage Range (mg-min/m$^3$) | Casualty Criteria | | | |
|---|---|---|---|---|
| | WIA | DOW | RTD | Convalescent |
| 0–4 | 0% | 0% | 0% | 0% |
| 4–12 | If criterion met: 100% | 0% | Day 3: 100% | 0% |
| 12–26 | If criterion met: 100% | 0% | Day 4: 100% | 0% |
| 26–50 | If criterion met: 100% | 0% | Day 5: 100% | 0% |
| 50–70 | If criterion met: 100% | 0% | Day 14: 100% | 0% |
| >70 | 100% | Day 1: 0.1%<br>Day 2: 0.3%<br>Day 3: 0.7%<br>Day 4: 1.1%<br>Day 5: 3.0%<br>Days 6–16: 0.8% each | Week 3: 7.5%<br>Week 4: 9.6%<br>Week 5: 14.7%<br>Week 6: 17.5% | 36.7% |

## B. Radiological Injury Profiles (Section 106)

### 1. Additions

The new sections 106.2 and 106.4, below, describe the impact of medical care on radiation casualty estimates, and should be inserted into Section A106 following the cutaneous radiological injury profile tables and figures and whole body radiation injury profiles and tables, respectively. The current Section A106.2 should be renumbered as Section A106.3.

#### a. A106.2 Cutaneous Radiation Medical Care Parameters

Treatment for cutaneous radiation injury is supportive, focusing on infection control, wound care, and pain management. Due to the prolonged symptomatology expected in cutaneous radiation injury, and the supportive nature of medical care, cutaneous radiation modeling parameters will be the same for treated and untreated casualties. The number and type of estimated casualties will remain the same, and no DOWs are expected. Based on existing injury profiles, at dose ranges of 40 Gy or less, symptoms are expected to dissipate and casualties can be returned to duty within three days. At higher dose ranges, symptoms do not abate for several weeks, and casualties are assumed to remain convalescent. Cutaneous radiation medical care parameters are provided in Table A-xx, below.

**Table 4. Cutaneous Radiation Medical Care Parameters**

| Dose Range (Gy) | Casualty Criteria | | | |
|---|---|---|---|---|
| | WIA | DOW | RTD | Convalescent |
| <2 | 0% | 0% | 0% | 0% |
| 2–<15 | 100% | 0% | Day 3: 100% | 0% |
| 15–<40 | 100% | 0% | Day 3: 100% | 0% |
| 40–<550 | 100% | 0% | 0% | 100% |
| ≥550 | 100% | 0% | 0% | 100% |

### b. A106.4 Whole Body Radiation Medical Care Parameters

1. Supportive care. Consideration of medical care can result in significantly different estimates of whole-body radiation casualties than when medical care is not considered. Supportive care has been shown to increase the median lethal dose and decrease the severity of radiation symptoms; these effects are typically expressed as a dose-reduction factor (DRF). Based on analysis of available literature and current operational resource capabilities,[4] a DRF of 1.3 is used to characterize the impact of supportive care. Adoption of this DRF causes the untreated whole-body radiation dose bands (see Table A-22) to shift to the dose bands shown in Table A-xx, below:

[4] Carl A. Curling et al., *The Impact of Medical Care on Casualty Estimates from Battlefield Exposure to Chemical, Biological and Radiological Agents and Nuclear Weapon Effects*, IDA Document D-4465 (Alexandria, VA: Institute for Defense Analyses, December 2011).

**Table 5. Whole-Body Radiation Dose Ranges with Supportive Care**

| Dose Range(Gy) (Untreated) | Dose Range(Gy) (Supportive Care) | Description |
|---|---|---|
| <1.25 | <3 | No observable effect in the majority of the population |
| 1.25–<3 | 3–<4 | A slight decrease in white blood cell and platelet count with possible beginning symptoms of bone marrow damage; survival is > 90% unless there are other injuries |
| 3–< 5.3 | 4–<7 | Moderate to severe bone marrow damage occurs; lethality ranges from $LD_{5/60}$ to $LD_{10/60}$ to $LD_{50/60}$; these patients require greater than 30 days recovery, but other injuries would increase the injury severity and probability of death |
| 5.3–<8.3 | 7–<11 | Severe bone marrow damage occurs; lethality ranges from $LD_{50/60}$ to $LD_{99/60}$; death occurs within 3.5 to 6 weeks with the radiation injury alone but is accelerated with other injuries; with other injuries, death may occur within 2 weeks |
| ≥8.3 | ≥10* | Bone marrow pancytopenia and moderate intestinal damage occur including diarrhea; death is expected within 2 to 3 weeks; with other injuries, death may occur within 2 weeks; at higher doses, combined gastrointestinal (GI) and bone marrow damage occur with hypotension and death is expected within 1 to 2.5 weeks or if other injuries are also present, within 6 days |

Note: * 10 Gy is assumed to be the upper limit of efficacy of supportive care, due to the onset of very severe symptoms associated with the gastrointestinal and neurovascular syndromes.

2. Radiation antiemetics. Antiemetic drugs suppress the upper gastrointestinal (GI) symptoms of acute radiation sickness; studies have shown significant decreases in the severity of nausea and vomiting for radiation levels up to 10 Gy. Taking anti-emetics upon receiving radiation and at the recommended dose from then on brought the upper GI severity to zero (No Observable Effect) for the first 24 hours and one (Mild) for days after that. With the use of antiemetics alone (in the absence of other medical treatment):

- At the 1.25–<3 Gy level, patients receiving antiemetics show no symptoms of radiation exposure.
- At the dose range of 3 to 5.3 Gy, individuals do not exhibit symptoms at Severity Level 2, or more, until after 200 hours if they receive antiemetics, as compared to two hours if they are not treated.
- At the dose range of 5.3 to 8.3 Gy, individuals do not reach Severity Level 1 until after 24 hours and do not reach Severity Level 2 until after 100 hours if they receive antiemetics.
- At the dose range of 8.3 to 10 Gy, individuals exhibit symptoms at Severity Level 3 after 4 hours with antiemetics.

Although it is conceivable that supportive medical care may be provided and not include radiation antiemetics, it is regarded as unlikely that radiation antiemetics would be provided

without (at least) supportive medical care. When estimating casualties considering both supportive care and the use of antiemetics, the untreated whole-body radiation dose bands will shift to account for both the DRF associated with supportive care and the suppression of upper gastrointestinal symptoms by antiemetics. The whole-body radiation dose bands that should be used when considering antiemetics are shown in Table A-xx below:

**Table 6. Whole-Body Radiation Dose Ranges with Supportive Care and Antiemetics**

| Dose Range(Gy) | Description (Supportive Care with Antiemetics) |
|---|---|
| <3 | No observable effect in the majority of the population |
| 3–<5.3 | *Only mild upper gastrointestinal symptoms (UGI suppressed by antiemetics in the 3-5.3 Gy dose range), and no other symptoms* |
| 5.3–<7 | *Mild upper gastrointestinal symptoms (UGI suppressed by antiemetics in the 5.3–8.3 Gy dose range, and other symptoms associate with the (untreated/unshifted) dose range for the 3–5.3 Gy dose range:*<br>Moderate to severe bone marrow damage occurs; lethality ranges from $LD_{5/60}$ to $LD_{10/60}$ to $LD_{50/60}$; these patients require greater than 30 days recovery, but other injuries would increase the injury severity and possible death |
| 7–<8.3 | *Mild upper gastrointestinal symptoms (UGI suppressed by antiemetics in the 5.3–8.3 Gy dose range), and other symptoms associate with the (untreated/unshifted) dose range for the 5.3-8.3 Gy dose range:*<br>Severe bone marrow damage occurs; lethality ranges from $LD_{50/60}$ to $LD_{99/60}$; death occurs within 3.5 to 6 weeks with the radiation injury alone but is accelerated with other injuries; with other injuries, death may occur within 2 weeks |
| 8.3–<10 | *Mild upper gastrointestinal symptoms (UGI suppressed by antiemetics in the > 8.3 Gy dose range), and other symptoms associate with the (untreated/unshifted) dose range for the 5.3–8.3 Gy dose range:*<br>Severe bone marrow damage occurs; lethality ranges from $LD_{50/60}$ to $LD_{99/60}$; death occurs within 3.5 to 6 weeks with the radiation injury alone but is accelerated with other injuries; with other injuries, death may occur within 2 weeks |
| ≥10* | *Severe upper gastrointestinal symptoms, unsuppressed by antiemetics in the >10 Gy dose range, and other symptoms associate with the (untreated/unshifted) dose range for the >8.3 Gy dose range:*<br>Bone marrow pancytopenia and moderate intestinal damage occur including diarrhea; death is expected within 2 to 3 weeks; with other injuries, death may occur within 2 weeks; at higher doses, combined gastrointestinal and bone marrow damage occur with hypotension and death is expected within 1 to 2.5 weeks or if other injuries are also present, within 6 days |

3. Whole-body radiation injury profiles, with treatment. Because of the suppression of upper GI symptoms with antiemetics, the associated symptom progression maps will change, with corresponding changes to the whole-body radiation injury profiles. Table A-xx shows whole-body radiation symptom severity over time by dose range.

**Table 7. Symptom Severity by Whole-Body Radiation Dose Range, with Medical Treatment**

| Time Point (hr) | Dose Range* | | | | |
|---|---|---|---|---|---|
| | 3–< 5.3 Gy | 5.3–< 7 Gy | 7–< 8.3 Gy | 8.3–< 10 Gy | ≥ 10 Gy |
| 0.1 | 0 | 0 | 0 | 0 | 0 |
| 0.2 | 0 | 0 | 0 | 0 | 0 |
| 0.3 | 0 | 0 | 0 | 0 | 3 |
| 0.4 | 0 | 0 | 0 | 0 | 3 |
| 0.5 | 0 | 0 | 0 | 0 | 3 |
| 0.6 | 0 | 0 | 0 | 0 | 3 |
| 0.7 | 0 | 0 | 0 | 0 | 3 |
| 0.8 | 0 | 0 | 0 | 0 | 3 |
| 0.9 | 0 | 0 | 0 | 0 | 3 |
| 1 | 0 | 0 | 0 | 0 | 3 |
| 2 | 0 | 0 | 0 | 0 | 3 |
| 3 | 0 | 0 | 0 | 0 | 3 |
| 4 | 0 | 0 | 0 | 0 | 3 |
| 5 | 0 | 0 | 0 | 0 | 3 |
| 6 | 0 | 0 | 0 | 0 | 3 |
| 7 | 0 | 0 | 0 | 0 | 3 |
| 8 | 0 | 0 | 0 | 0 | 3 |
| 9 | 0 | 0 | 0 | 0 | 3 |
| 10 | 0 | 0 | 0 | 0 | 3 |
| 20 | 0 | 0 | 0 | 0 | 3 |
| 30 | 1 | 1 | 1 | 1 | 3 |
| 40 | 1 | 1 | 1 | 1 | 3 |
| 50 | 0 | 1 | 1 | 1 | 3 |
| 60 | 0 | 1 | 1 | 1 | 3 |
| 70 | 0 | 1 | 1 | 1 | 3 |
| 80 | 0 | 1 | 1 | 1 | 3 |
| 90 | 0 | 0 | 1 | 1 | 3 |
| 100 | 0 | 0 | 2 | 2 | 3 |
| 200 | 0 | 2 | 3 | 3 | 4 |
| 300 | 0 | 2 | 3 | 3 | 4 |
| 336 | 0 | 2 | 3 | 3 | 4 |
| 400 | 0 | 2 | 3 | 3 | 4 |
| 500 | 0 | 2 | 3 | 3 | 4 |
| 600 | 0 | 2 | 4 | 4 | 4 |
| 700 | 0 | 3 | 4 | 4 | 4 |
| 800 | 0 | 3 | 4 | 4 | 4 |
| 900 | 0 | 3 | 4 | 4 | 4 |
| 1000 | 0 | 3 | 4 | 4 | 4 |

Note: * For doses > 6 Gy, time to death is calculated; the injury profile is followed as described until time of death, which may occur up to or later than six weeks following exposure.

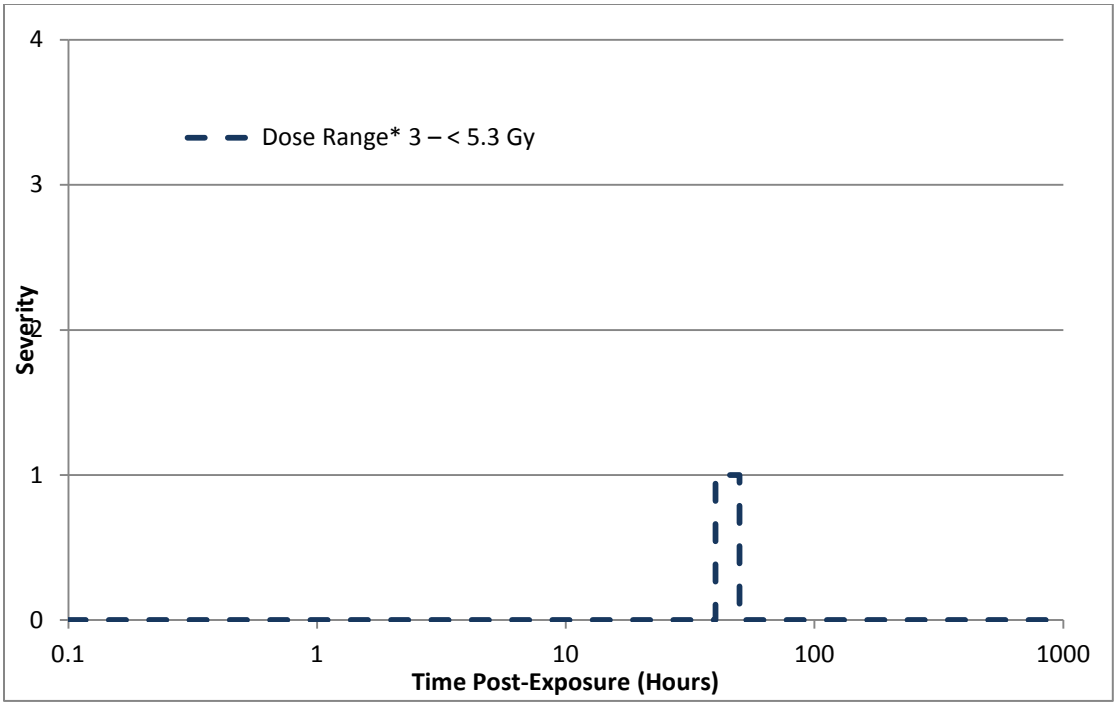


**Figure 2. Casualty Severity for Whole Body Radiation Dose Range 3–<5.3 Gy, with Treatment**

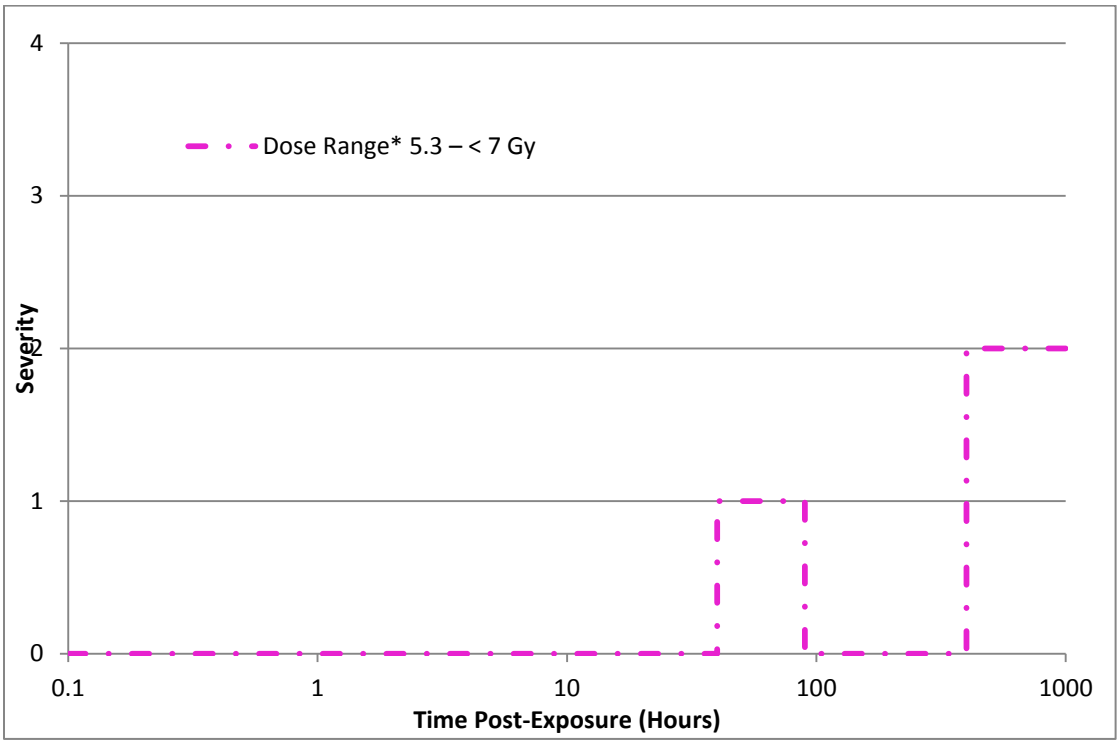


**Figure 3. Casualty Severity for Whole Body Radiation Dose Range 5.3–<7 Gy, with Treatment**

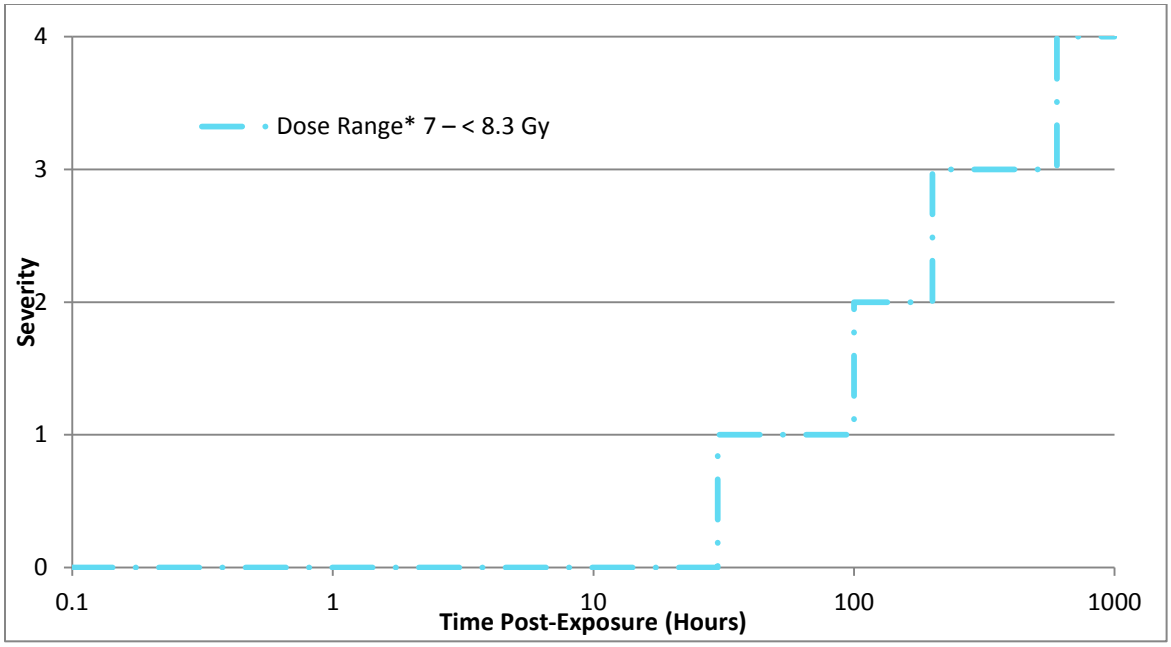


**Figure 4. Casualty Severity for Whole Body Radiation Dose Range 7–<8.3 Gy, with Treatment**

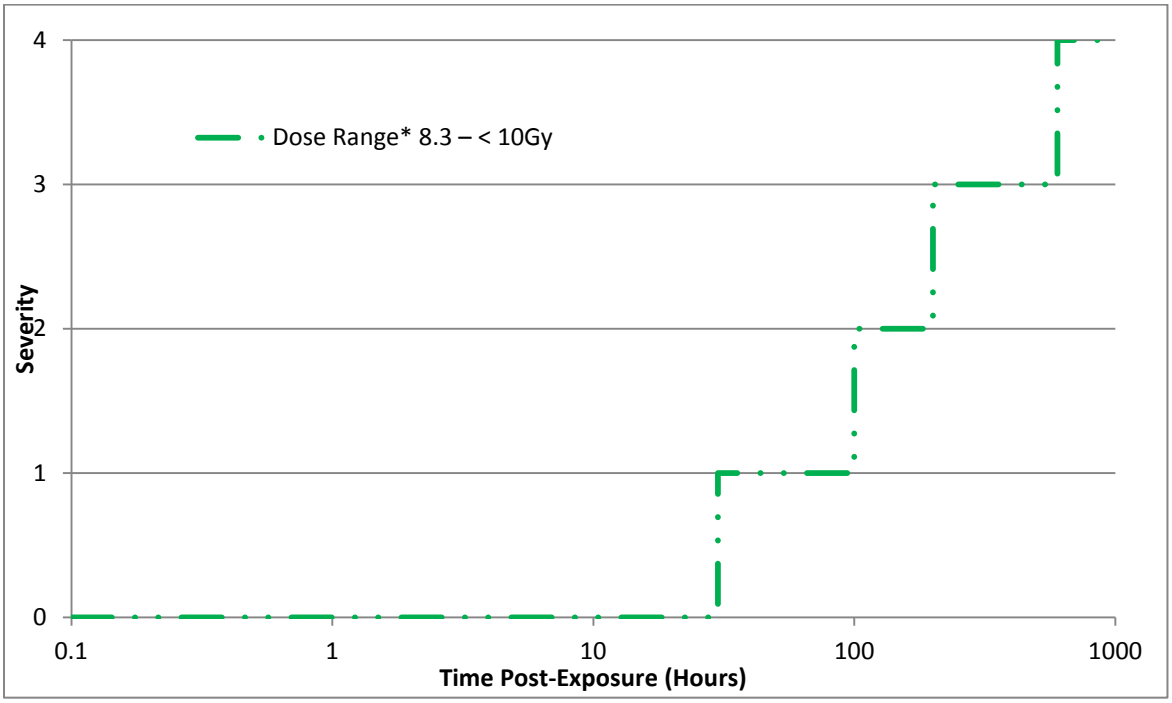


**Figure 5. Casualty Severity for Whole Body Radiation Dose Range 8.3–<10 Gy, with Treatment**

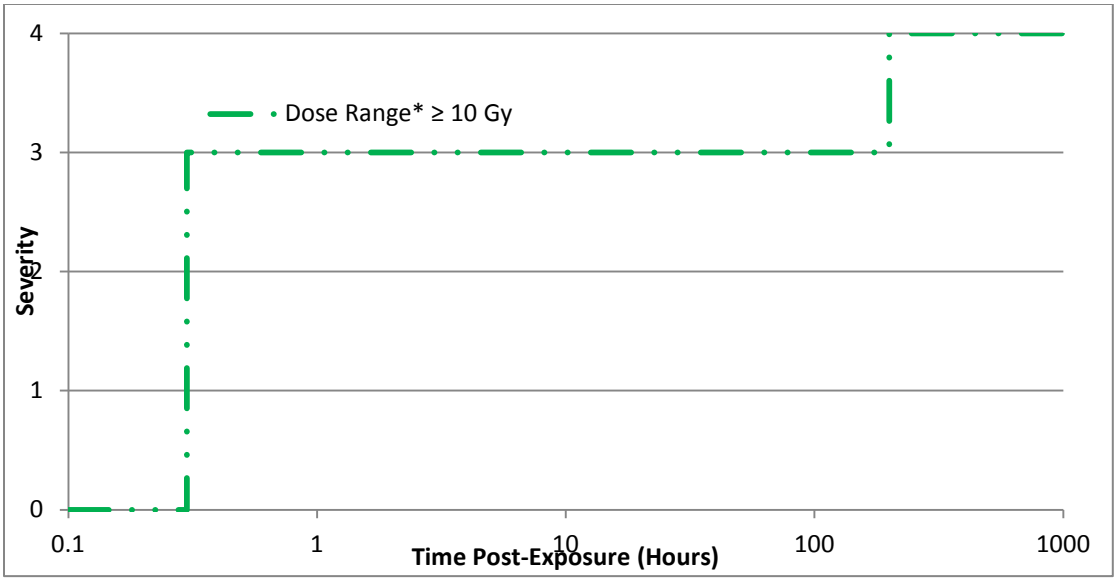


**Figure 6. Casualty Severity for Whole Body Radiation Dose Range ≥10 Gy, with Treatment**

4. Medical care modeling parameters. The number and timing of treated whole-body radiation casualties who recover, die, or enter convalescent care are determined using the parameters provided in Table A-xx, below. These parameters are derived from Table A-xx, above. RTD was not modeled at doses above 5.3 Gy since at six weeks the patient is still modeled as being at a Severity Level of 3. Past this point, the patient would remain in medical care for a period of time and have a long convalescence thereafter. DOWs will still occur, but at a higher dose range than would normally be expected without treatment. With supportive medical treatment, it is expected that the $LD_{50}$ would increase from 4.5 Gy to about 5.9 Gy. At doses above 6 Gy, death would be expected at the time modeled by the radiation time-to-death model.

**Table 8. Medical Care Modeling Parameters for Whole Body Radiation**

| Dose Range (Gy) | Casualty Criteria | | | |
|---|---|---|---|---|
| | WIA | DOW | RTD | Convalescent |
| <3 | 0% | 0% | 0% | 0% |
| 3–<5.3 | 100% [at WIA(1)] | 0% | Day 3: 100% | 0% |
| 5.3–<7 | 100% | 100% (above 6 Gy) | 0% | 100% (below 6 Gy) |
| 7–<8.3 | 100% | 100% | 0% | 0% |
| 8.3–<10 | 100% | 100% | 0% | 0% |
| ≥ 10 | 100% | 100% | 0% | 0% |

## C. Nuclear Injury Profiles (Section 107)

### 1. Additions

The new sections 107.3 and 107.5, below, describe the impact of medical care on nuclear casualty estimates, and should be inserted into Section A107 following the blast injury tables and figures and thermal injury profiles and tables, respectively. The current Section A107.3 should be renumbered as Section A107.4.

#### a. A107.3 Medical Care Parameters for Primary Blast Injuries

**Table 9. Medical Care Parameters for Primary Blast Injuries**

| Exp. Range (kPa) | Casualty Criteria | | | |
|---|---|---|---|---|
| | WIA | DOW | RTD | Convalescent |
| <50 | 0% | 0% | 0% | 0% |
| 50–<140 | 100% | 0% | Week 1: 100% | 0% |
| 140–<240 | 100% | 0% | Week 3: 100% | 0% |
| 240–<290 | 100% | 0% | Week 5: 100% | 0% |
| ≥290 | 100% | 5–40% | 0% | 60–95% |

#### b. A107.5 Medical Care Parameters for Thermal Injuries

**Table 10. Medical Care Parameters for Thermal Injuries**

| Thermal Insult Range (%BSA) | Casualty Criteria | | | |
|---|---|---|---|---|
| | WIA | DOW | RTD | Convalescent |
| <1 | 0% | 0% | 0% | 0% |
| 1–<15 | 100% | 0% | Week 1–4: 100% | 0% |
| 15–<30 | 100% | <2% | Week 4–6: 50% | 50% |
| 30–<45 | 100% | 2–50% | 0% | >50% |
| ≥45 | 100% | 50–100% | 0% | <50% |

## D. Non-contagious Biological Agent Parameters and Lookup Tables (Section A108)

### 1. Modifications

Section A108:

*Line out:* This section contains the parameters needed to implement the methodology described in Section 0303.2 for the non-contagious diseases anthrax, botulism,

and Venezuelan equine encephalitis (VEE). The biological human response component of the methodology is discussed further in Annex C, Section C125, with specifics for the non-contagious biological agents described in sections C126 through C128.

*Line in:* This section contains the parameters needed to implement the methodology described in Section 0303.2 for the non-contagious agents anthrax, botulism, Venezuelan equine encephalitis (VEE), brucellosis, glanders, Q fever, SEB, and tularemia. The biological human response component of the methodology is discussed further in Annex C, Section C125, with specifics for the non-contagious biological agents described in sections C126 through C133.

**a. A108.1 Anthrax Parameters and Lookup Tables**

Paragraph A108.1.1 should be modified as follows:

*Line out:* The infective dose of anthrax is modeled as a random variable with an exponential distribution with parameter $\lambda = 1.69 \times 10^{-5}$,…

*Line in:* The infective dose of anthrax is modeled as a random variable with an exponential distribution with parameter $\lambda = 1.36 \times 10^{-5}$,…

*Line out:* $\lambda$ is the dose-response parameter [$= 1.69 \times 10^{-5}$].

*Line in:* $\lambda$ is the dose-response parameter [$= 1.36 \times 10^{-5}$].

ParagraphA108.1.2 should be modified as follows:

*Line out:* Therefore, $p_f(d_n) = 1$ for all values of $d_n$.

*Line in:* Therefore, for untreated anthrax, pf(dn) = pE(dn) for all values of dn. Treatment is modeled to decrease lethality only if antibiotics are administered in the initial, prodromal stage (Stage 1). If antibiotic treatment is initiated during Stage 1,

$$\text{pf-Anth(dn)} = (a + b*t)*\text{pE-Anth(dn)}$$

where:

t is the time after symptom onset to antibiotic treatment [days],

a = 0.1, and

b = 0.012.

If an individual has progressed to the second, fulminant stage (Stage 2) before treatment begins, lethality is modeled as a rate of 100%, (pf-Anth(dn) = pE-Anth(dn)), the same as for untreated individuals, even if antibiotics are administered during Stage 2.

Paragraph A108.1.3 should be replaced with:

3. Prophylaxis. Various combinations of vaccination and antibiotics are modeled as prophylaxis against anthrax. To model the protection afforded by prophylaxis, the number of people who will become ill (as determined by the infectivity model described above) is multiplied by the efficacy of the prophylaxis to determine what fraction of those individuals is protected. For either pre-exposure vaccination or post-exposure antibiotics alone, this efficacy (i.e., the probability of prevention of illness, if infected) is 0.90.[5] The 10% not protected from illness by vaccination are modeled to progress through the untreated non-survivor injury profile as if they never received prophylaxis; the 10% not protected by antibiotic prophylaxis also progress through the same injury profile, but not until the 60-day course of antibiotics has ended. Post-exposure antibiotic prophylaxis combined with either pre-exposure or post-exposure vaccination is modeled to be 100% efficacious in preventing the onset of disease, so the efficacy for these combinations is 1.0.[6]

The title of Table A-35 should be modified to read: "Injury Profile for Untreated Anthrax Non-Survivors."

The title of Table A-38 should be modified to read: "Fraction of Untreated People Ill with Anthrax Who Die on Specified Day."

The title of Figure A-50 should be modified to read: "Fraction of Untreated People Ill with Anthrax Who Die on Specified Day."

### a. A108.2 Botulism Parameters and Lookup Tables

Paragraph A108.2.1 should be modified as follows:

*Line out:* The probability of becoming ill with botulism is modeled as a log-probit function with a probit slope of 12.9 probits/log dose…

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5 As demonstrated by the experimental data, the efficacy of anthrax vaccine against the Ames strain is approximately 100%; against other strains of anthrax, the efficacy appears to be slightly reduced. Based on these findings as well as providing a conservative estimate of prophylaxis efficacy in humans against multiple anthrax strains, a prophylaxis efficacy of 0.90 is recommended. P. S. Brachman et al., "Field Evaluation of a Human Anthrax Vaccine," *American Journal of Public Health* 52, no. 4 (April 1962): 632–45; A. M. Friedlander et al., "Postexposure Prophylaxis against Experimental Inhalation Anthrax," *Journal of Infectious Diseases* 167, no. 5 (May 1993): 1239–43; M. L. M. Pitt et al., "Comparison of the Efficacy of Purified Protective Antigen and MDPH to Protect Non-Human Primates from Inhalation Anthrax," Special Supplement, *Salisbury Medical Bulletin* 87 (1996): 130; B. E. Ivins et al., "Efficacy of a Standard Human Anthrax Vaccine against *Bacillus anthracis* Aerosol Spore Challenge in Rhesus Monkeys," Special Supplement, *Salisbury Medical Bulletin* 87 (1996): 125–26; B. E. Ivins et al., "Comparative Efficacy of Experimental Anthrax Vaccine Candidates against Inhalational Anthrax in Rhesus Macaques," *Vaccine* 16, no. 11/12 (1998): 1141–48; and P. F. Fellows et al., "Efficacy of a Human Anthrax Vaccine in Guinea Pigs, Rabbits, and Rhesus Macaques against Challenge by *Bacillus anthracis* Isolates of Diverse Geographic Origin," *Vaccine* 19 (2001): 3241–47.

6 Arthur M. Friedlander et al., "Postexposure Prophylaxis against Experimental Inhalation Anthrax," *Journal of Infectious Diseases* 167, no. 5 (1993). Nicholas J. Vietri et al., "Short-Course Postexposure Antibiotic Prophylaxis Combined with Vaccination Protects against Experimental Inhalational Anthrax" *Proceedings of the National Academy of Sciences* 103, no. 20 (2006).

*Line in:* The probability of becoming ill with botulism is modeled as a log-probit function with a probit slope of 12.5 probits/log dose…

*Line out:* m is the probit slope [= 12.9 probits/log dose],

σis the standard deviation of the variable's natural logarithm [= $e^{1/m}$= $e^{1/12.9}$= 1.0806], and

*Line in:* m is the probit slope [= 12.5 probits/log dose],

σis the standard deviation of the variable's natural logarithm [= $e^{1/m}$= $e^{1/12.5}$= 1.0833], and

Section A108.2.2 page A-44:

*Line out:* Botulism lethality is modeled (similar to its effectivity) as a dose-dependent log-probit distribution with a probit slope of 12.9 probits/log dose…

*Line in:* a. Without treatment, botulism lethality is modeled (similar to its effectivity) as a dose-dependent log-probit distribution with a probit slope of 12.5 probits/log dose…

*Line out:* m is the probit slope [= 12.9 probits/log dose],

σis the standard deviation of the variable's natural logarithm [= $e^{1/m}$= $e^{1/12.9}$= 1.0806], and

*Line in:* m is the probit slope [= 12.5 probits/log dose],

σis the standard deviation of the variable's natural logarithm [= $e^{1/m}$= $e^{1/12.5}$= 1.0833], and

(Note that Figures A-51 and A-52 need not change because the difference is imperceptible at this scale.)

The title of Figure A-52 should be modified to read: "Dose-Related Probability of Death from Untreated Botulism."

The title of Table A-39 should be modified to read: "Injury Profile for Untreated Botulism Survivors."

The title of Table A-40 should be modified to read: "Injury Profile for Untreated Botulism Non-Survivors."

The note to Table A-41 should be modified to read: "Table to be used for survivors and non-survivors (treated and untreated).

The title of Table A-42 should be modified to read: "Fraction of Untreated Botulism Survivors Who Enter Stage 2 of Illness on Specified Day." Similarly, the header of the second column in Table A-42 should be changed to "Stage 2—Untreated Survivors."

The title of Figure A-54 should be modified to read: "Fraction of Untreated Botulism Survivors Who Enter Stage 2 of Illness on Specified Day."

The title of Table A-43 should be modified to read: "Fraction of Untreated Botulism Non-Survivors Who Enter Stage 2 of Illness on Specified Day. Similarly, the header of the second column in Table A-43 should be changed to "Stage 2—Untreated Non-Survivors."

The title of Figure A-55 should be changed to read: "Fraction of Untreated Botulism Non-Survivors Who Enter Stage 2 of Illness on Specified Day."

The title of Table A-44 should be modified to read: "Fraction of Untreated Botulism Non-Survivors Who Die on Specified Day." Similarly, the header of the second column in Table A-44 should be changed to "DOW—Untreated Non-Survivors."

The title of Figure A-56 should be modified to read: "Fraction of Untreated Botulism Non-Survivors Who Die on Specified Day."

## 2. Additions

The following sections describe the parameters needed to implement the *AMedP-8(C)* methodology to include consideration of medical care and the five additional biological agents. The daily casualty tables for each agent were derived by convolving the time-based distributions representing the incubation period and the duration of illness according to the methods described in the *Technical Reference Manual: Allied Medical Publication 8(C), NATO Planning Guide for the Estimation of Chemical, Biological, Radiological, and Nuclear (CBRN) Casualties.*[7] These time-based distributions are described in detail in the next chapter.

### a. A108.1 Anthrax Parameters and Lookup Tables

Tables 11 and 12, below, should be inserted after Table A-35, Injury Profile for Untreated Anthrax Non-Survivors, using the standard *AMedP-8(C)* table format:

**Table 11. Injury Profile for Treated Anthrax Non-Survivors**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 2 |
| 2 | 4 |

[7] Carl A. Curling et al., *Technical Reference Manual: Allied Medical Publication 8(C), NATO Planning Guide for the Estimation of Chemical, Biological, Radiological, and Nuclear (CBRN) Casualties*, IDA Document D-4082 (Alexandria, VA: Institute for Defense Analyses, June 2010).

**Table 12. Injury Profile for Treated Anthrax Survivors**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 2 |
| 2 | 4 |
| 3 | 3 |
| 4 | 2 |

Table 13, Table 14, Table 15, Figure 7, Figure 8, and Figure 9 below should be inserted after Figure A-50, Fraction of Untreated People Ill with Anthrax Who Die on Specified Day.

**Table 13. Fraction of Treated Anthrax Survivors Who Enter Convalescence on Specified Day Given Dose, with Treatment Initiated in Stage 1**

| | Dose | | | | |
|---|---|---|---|---|---|
| Day | $\leq 10^3$ spores | $10^3 < - \leq 10^4$ spores | $10^4 < - \leq 10^5$ spores | $10^5 < - \leq 10^6$ spores | $> 10^6$ spores |
| 12 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 13 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 14 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0003 |
| 15 | 0.0000 | 0.0000 | 0.0001 | 0.0005 | 0.0099 |
| 16 | 0.0005 | 0.0007 | 0.0017 | 0.0082 | 0.0584 |
| 17 | 0.0034 | 0.0053 | 0.0120 | 0.0420 | 0.1348 |
| 18 | 0.0124 | 0.0196 | 0.0407 | 0.1031 | 0.1821 |
| 19 | 0.0291 | 0.0454 | 0.0845 | 0.1567 | 0.1790 |
| 20 | 0.0509 | 0.0766 | 0.1251 | 0.1737 | 0.1448 |
| 21 | 0.0721 | 0.1030 | 0.1460 | 0.1557 | 0.1038 |
| 22 | 0.0878 | 0.1175 | 0.1435 | 0.1209 | 0.0690 |
| 23 | 0.0956 | 0.1186 | 0.1243 | 0.0852 | 0.0438 |
| 24 | 0.0958 | 0.1094 | 0.0982 | 0.0564 | 0.0272 |
| 25 | 0.0903 | 0.0941 | 0.0724 | 0.0359 | 0.0167 |
| 26 | 0.0811 | 0.0769 | 0.0508 | 0.0224 | 0.0103 |
| 27 | 0.0704 | 0.0604 | 0.0344 | 0.0138 | 0.0065 |
| 28 | 0.0594 | 0.0461 | 0.0227 | 0.0086 | 0.0041 |
| 29 | 0.0492 | 0.0344 | 0.0148 | 0.0054 | 0.0027 |
| 30 | 0.0402 | 0.0253 | 0.0096 | 0.0035 | 0.0018 |
| 31 | 0.0324 | 0.0184 | 0.0062 | 0.0023 | 0.0012 |
| 32 | 0.0260 | 0.0133 | 0.0040 | 0.0015 | 0.0009 |
| 33 | 0.0207 | 0.0095 | 0.0026 | 0.0010 | 0.0006 |
| 34 | 0.0165 | 0.0068 | 0.0018 | 0.0007 | 0.0004 |
| 35 | 0.0131 | 0.0049 | 0.0012 | 0.0005 | 0.0003 |
| 36 | 0.0104 | 0.0035 | 0.0008 | 0.0004 | 0.0003 |

| | Dose | | | | |
|---|---|---|---|---|---|
| Day | ≤ $10^3$ spores | $10^3$ < - ≤ $10^4$ spores | $10^4$ < - ≤ $10^5$ spores | $10^5$ < - ≤ $10^6$ spores | > $10^6$ spores |
| 37 | 0.0083 | 0.0026 | 0.0006 | 0.0003 | 0.0002 |
| 38 | 0.0066 | 0.0019 | 0.0004 | 0.0002 | 0.0002 |
| 39 | 0.0053 | 0.0014 | 0.0003 | 0.0002 | 0.0001 |
| 40 | 0.0042 | 0.0010 | 0.0002 | 0.0001 | 0.0001 |
| 41 | 0.0034 | 0.0007 | 0.0002 | 0.0001 | 0.0001 |
| 42 | 0.0027 | 0.0006 | 0.0001 | 0.0001 | 0.0001 |
| 43 | 0.0022 | 0.0004 | 0.0001 | 0.0001 | 0.0001 |
| 44 | 0.0018 | 0.0003 | 0.0001 | 0.0001 | 0.0000 |
| 45 | 0.0014 | 0.0002 | 0.0001 | 0.0001 | 0.0000 |
| 46 | 0.0012 | 0.0002 | 0.0001 | 0.0000 | 0.0000 |
| 47 | 0.0010 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| 48 | 0.0008 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| 49 | 0.0006 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| 50 | 0.0005 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| 51 | 0.0004 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| 52 | 0.0004 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 53 | 0.0003 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 54 | 0.0003 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 55 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 56 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 57 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 58 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 59 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 60 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 61 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| >61 | 0.0005 | 0.0001 | 0.0001 | 0.0000 | 0.0000 |

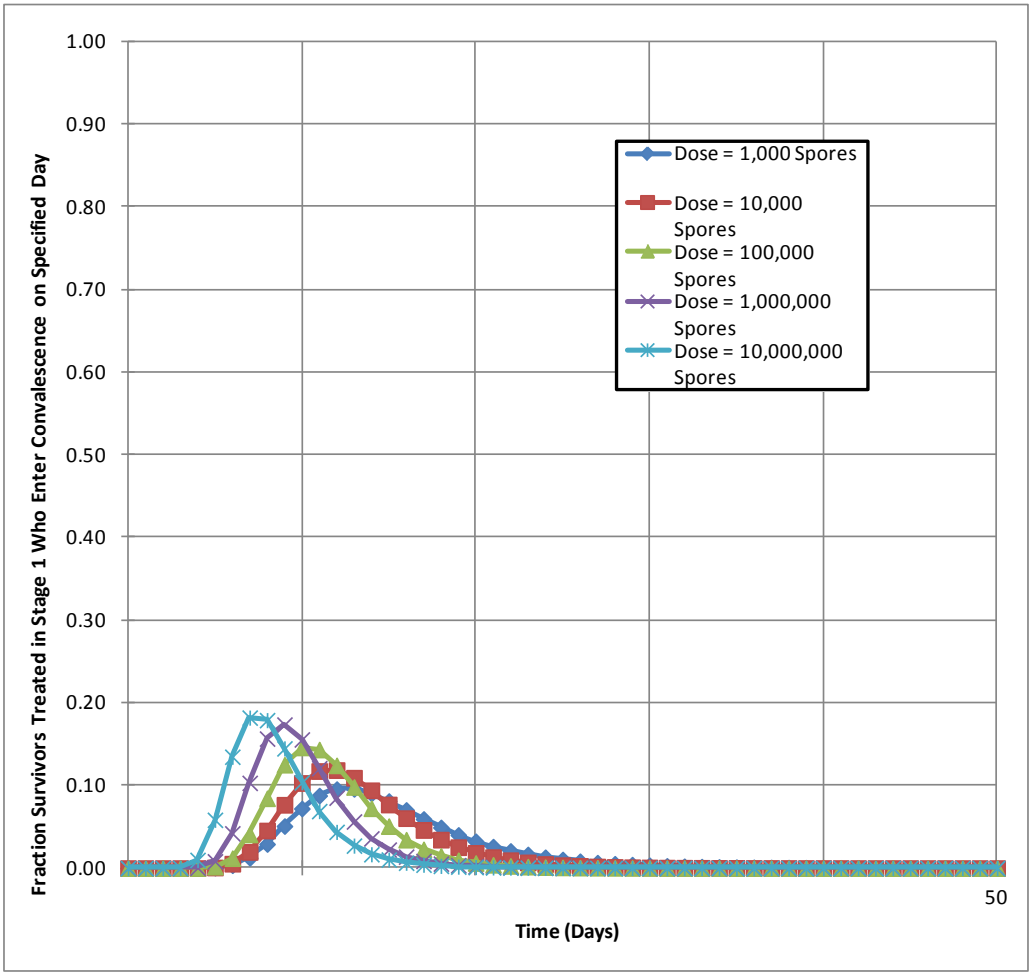


**Figure 7. Fraction of Treated Anthrax Survivors Who Enter Convalescence on Specified Day Given Dose, with Treatment Initiated in Stage 1**

**Table 14. Fraction of Treated Anthrax Non-Survivors Who Die on Specified Day Given Dose, with Treatment Initiated in Stage 1**

| | Dose | | | | |
|---|---|---|---|---|---|
| Day | $\leq 10^3$ spores | $10^3 < - \leq 10^4$ spores | $10^4 < - \leq 10^5$ spores | $10^5 < - \leq 10^6$ spores | $> 10^6$ spores |
| 1 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 3 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0003 |
| 4 | 0.0000 | 0.0000 | 0.0001 | 0.0005 | 0.0099 |
| 5 | 0.0005 | 0.0007 | 0.0017 | 0.0082 | 0.0584 |
| 6 | 0.0034 | 0.0053 | 0.0120 | 0.0420 | 0.1348 |
| 7 | 0.0124 | 0.0196 | 0.0407 | 0.1031 | 0.1821 |
| 8 | 0.0291 | 0.0454 | 0.0845 | 0.1567 | 0.1790 |
| 9 | 0.0509 | 0.0766 | 0.1251 | 0.1737 | 0.1448 |
| 10 | 0.0721 | 0.1030 | 0.1460 | 0.1557 | 0.1038 |
| 11 | 0.0878 | 0.1175 | 0.1435 | 0.1209 | 0.0690 |
| 12 | 0.0956 | 0.1186 | 0.1243 | 0.0852 | 0.0438 |
| 13 | 0.0958 | 0.1094 | 0.0982 | 0.0564 | 0.0272 |
| 14 | 0.0903 | 0.0941 | 0.0724 | 0.0359 | 0.0167 |
| 15 | 0.0811 | 0.0769 | 0.0508 | 0.0224 | 0.0103 |
| 16 | 0.0704 | 0.0604 | 0.0344 | 0.0138 | 0.0065 |
| 17 | 0.0594 | 0.0461 | 0.0227 | 0.0086 | 0.0041 |
| 18 | 0.0492 | 0.0344 | 0.0148 | 0.0054 | 0.0027 |
| 19 | 0.0402 | 0.0253 | 0.0096 | 0.0035 | 0.0018 |
| 20 | 0.0324 | 0.0184 | 0.0062 | 0.0023 | 0.0012 |
| 21 | 0.0260 | 0.0133 | 0.0040 | 0.0015 | 0.0009 |
| 22 | 0.0207 | 0.0095 | 0.0026 | 0.0010 | 0.0006 |
| 23 | 0.0165 | 0.0068 | 0.0018 | 0.0007 | 0.0004 |
| 24 | 0.0131 | 0.0049 | 0.0012 | 0.0005 | 0.0003 |
| 25 | 0.0104 | 0.0035 | 0.0008 | 0.0004 | 0.0003 |
| 26 | 0.0083 | 0.0026 | 0.0006 | 0.0003 | 0.0002 |
| 27 | 0.0066 | 0.0019 | 0.0004 | 0.0002 | 0.0002 |
| 28 | 0.0053 | 0.0014 | 0.0003 | 0.0002 | 0.0001 |
| 29 | 0.0042 | 0.0010 | 0.0002 | 0.0001 | 0.0001 |
| 30 | 0.0034 | 0.0007 | 0.0002 | 0.0001 | 0.0001 |
| 31 | 0.0027 | 0.0006 | 0.0001 | 0.0001 | 0.0001 |
| 32 | 0.0022 | 0.0004 | 0.0001 | 0.0001 | 0.0001 |
| 33 | 0.0018 | 0.0003 | 0.0001 | 0.0001 | 0.0000 |
| 34 | 0.0014 | 0.0002 | 0.0001 | 0.0001 | 0.0000 |
| 35 | 0.0012 | 0.0002 | 0.0001 | 0.0000 | 0.0000 |

| | Dose | | | | |
|---|---|---|---|---|---|
| Day | ≤ $10^3$ spores | $10^3$ < - ≤ $10^4$ spores | $10^4$ < - ≤ $10^5$ spores | $10^5$ < - ≤ $10^6$ spores | > $10^6$ spores |
| 36 | 0.0010 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| 37 | 0.0008 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| 38 | 0.0006 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| 39 | 0.0005 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| 40 | 0.0004 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| 41 | 0.0004 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 42 | 0.0003 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 43 | 0.0003 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 44 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 45 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 46 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 47 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 48 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 49 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 50 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| >50 | 0.0005 | 0.0001 | 0.0001 | 0.0000 | 0.0000 |

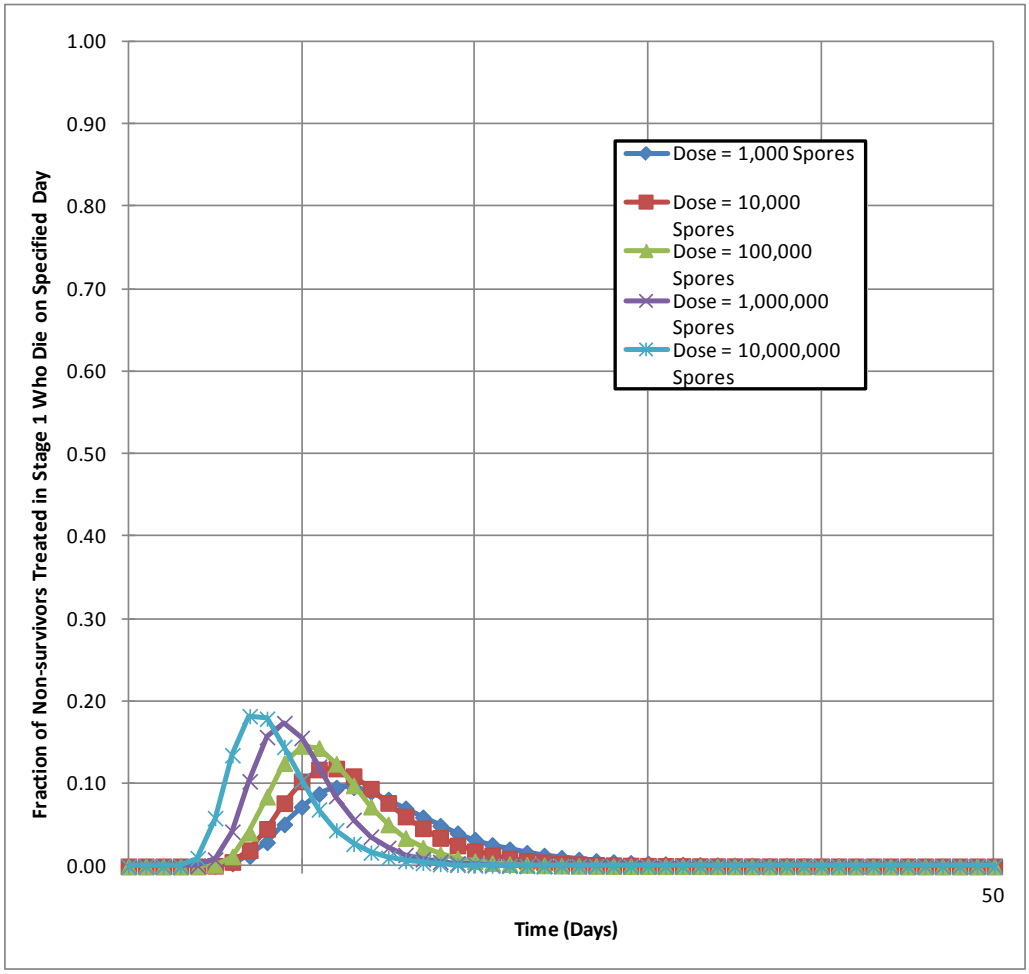


**Figure 8. Fraction of Treated Anthrax Non-Survivors Who Die on Specified Day Given Dose, with Treatment Initiated in Stage 1**

**Table 15. Fraction of Treated Anthrax Non-Survivors Who Die on Specified Day Given Dose, with Treatment Initiated in Stage 2**

| | Dose | | | | |
|---|---|---|---|---|---|
| Days | $\leq 10^3$ spores | $10^3 < \leq 10^4$ spores | $10^4 < \leq 10^5$ spores | $10^5 < \leq 10^6$ spores | $> 10^6$ spores |
| 1 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0004 |
| 3 | 0.0000 | 0.0001 | 0.0001 | 0.0009 | 0.0212 |
| 4 | 0.0010 | 0.0015 | 0.0034 | 0.0166 | 0.1020 |
| 5 | 0.0063 | 0.0098 | 0.0220 | 0.0721 | 0.1768 |
| 6 | 0.0197 | 0.0312 | 0.0631 | 0.1416 | 0.1893 |
| 7 | 0.0405 | 0.0627 | 0.1108 | 0.1759 | 0.1592 |
| 8 | 0.0632 | 0.0933 | 0.1420 | 0.1667 | 0.1176 |
| 9 | 0.0819 | 0.1133 | 0.1476 | 0.1342 | 0.0810 |
| 10 | 0.0930 | 0.1194 | 0.1330 | 0.0978 | 0.0537 |
| 11 | 0.0961 | 0.1137 | 0.1085 | 0.0672 | 0.0349 |
| 12 | 0.0928 | 0.1006 | 0.0825 | 0.0445 | 0.0224 |
| 13 | 0.0851 | 0.0841 | 0.0597 | 0.0290 | 0.0144 |
| 14 | 0.0751 | 0.0676 | 0.0418 | 0.0187 | 0.0093 |
| 15 | 0.0644 | 0.0526 | 0.0285 | 0.0120 | 0.0060 |
| 16 | 0.0540 | 0.0400 | 0.0191 | 0.0078 | 0.0039 |
| 17 | 0.0445 | 0.0299 | 0.0127 | 0.0050 | 0.0026 |
| 18 | 0.0363 | 0.0221 | 0.0084 | 0.0033 | 0.0017 |
| 19 | 0.0293 | 0.0161 | 0.0055 | 0.0022 | 0.0011 |
| 20 | 0.0235 | 0.0117 | 0.0037 | 0.0014 | 0.0008 |
| 21 | 0.0188 | 0.0084 | 0.0024 | 0.0010 | 0.0005 |
| 22 | 0.0150 | 0.0061 | 0.0016 | 0.0006 | 0.0004 |
| 23 | 0.0119 | 0.0044 | 0.0011 | 0.0004 | 0.0002 |
| 24 | 0.0095 | 0.0031 | 0.0007 | 0.0003 | 0.0002 |
| 25 | 0.0075 | 0.0023 | 0.0005 | 0.0002 | 0.0001 |
| 26 | 0.0060 | 0.0016 | 0.0003 | 0.0001 | 0.0001 |
| 27 | 0.0048 | 0.0012 | 0.0002 | 0.0001 | 0.0001 |
| 28 | 0.0038 | 0.0008 | 0.0002 | 0.0001 | 0.0000 |
| 29 | 0.0030 | 0.0006 | 0.0001 | 0.0001 | 0.0000 |
| 30 | 0.0024 | 0.0004 | 0.0001 | 0.0000 | 0.0000 |
| 31 | 0.0020 | 0.0003 | 0.0001 | 0.0000 | 0.0000 |
| 32 | 0.0016 | 0.0002 | 0.0000 | 0.0000 | 0.0000 |
| 33 | 0.0013 | 0.0002 | 0.0000 | 0.0000 | 0.0000 |
| 34 | 0.0010 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| 35 | 0.0008 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |

| | Dose | | | | |
|---|---|---|---|---|---|
| Days | ≤ $10^3$ spores | $10^3$ <– ≤ $10^4$ spores | $10^4$ <– ≤ $10^5$ spores | $10^5$ <– ≤ $10^6$ spores | > $10^6$ spores |
| 36 | 0.0007 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| 37 | 0.0006 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| 38 | 0.0005 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 39 | 0.0004 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 40 | 0.0003 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 41 | 0.0003 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 42 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 43 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 44 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 45 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 46 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 47 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 48 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 49 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 50 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| >50 | 0.0003 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

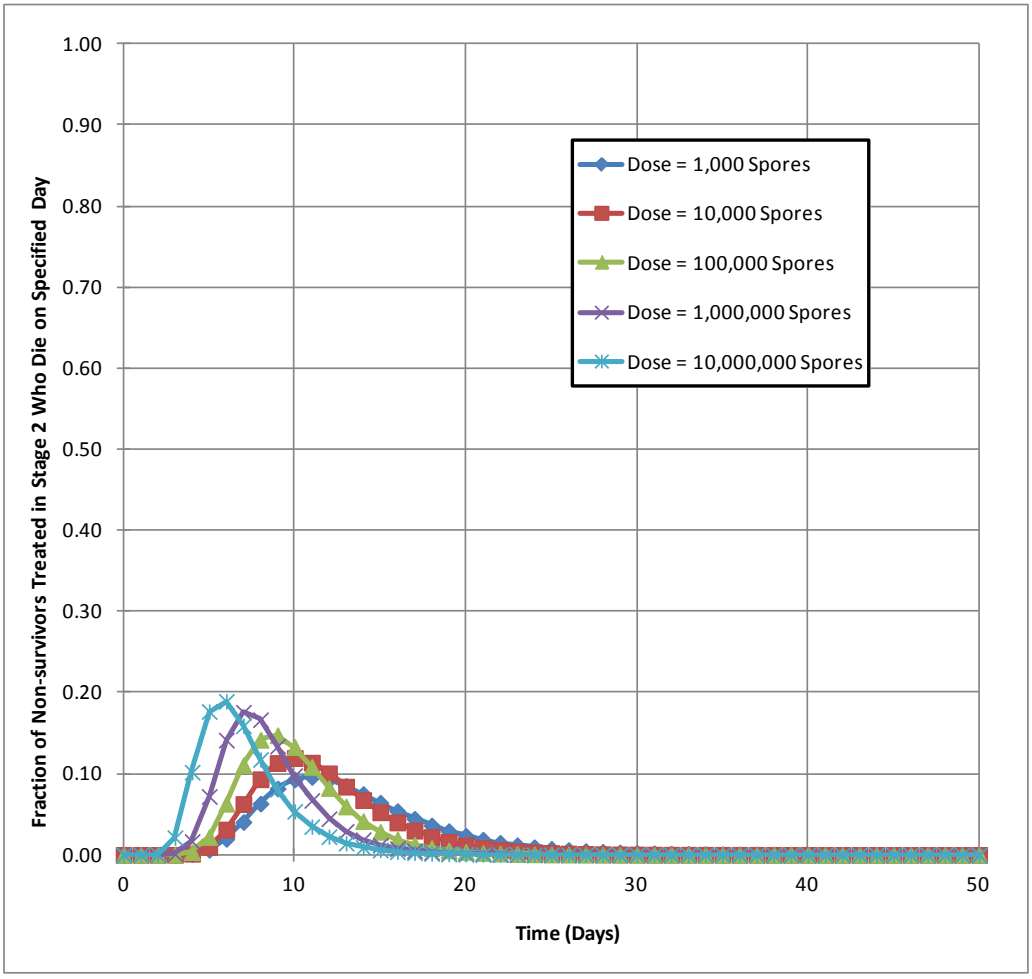


**Figure 9. Fraction of Treated Anthrax Non-Survivors Who Die on Specified Day Given Dose, with Treatment Initiated in Stage 2**

### b. A108.2 Botulism Parameters and Lookup Tables

The following paragraphs describe botulism lethality with treatment and botulism prophylaxis; they should be inserted after paragraph A0108.2.2(a):

b. The treated botulism lethality submodel relies and builds on the untreated lethality and duration of illness submodels to divide treated individuals into two main cohorts: those who require ventilation and those who do not. Dividing patients among these two cohorts requires information regarding when antitoxin would be administered and when ventilation would be needed. The time at which antitoxin would be administered is a user-provided input. The time at which ventilation would be required can be taken from the injury profile and duration of illness submodels for untreated botulism non-survivors, and is equal to the time at which an untreated non-survivor enters Stage 3 of illness.

1) The unventilated cohort comprises botulism casualties that would survive even without treatment, as calculated using the dose-dependent untreated lethality model

described above. It also includes casualties (otherwise expected to die in the absence of treatment) who are given antitoxin before entering the very severe Stage 3. Table A-XX "Fraction of People Ill with Botulism Who Enter Stage 3 of Illness on Specified Day" is used to determine when individuals enter Stage 3. All members of this cohort are expected to survive (unventilated survivors).

2) The ventilated cohort comprises all botulism casualties who progress to Stage 3 of illness before antitoxin is administered, at which point ventilation is assumed to be required. Among this cohort, 12% are expected to die even with treatment (ventilated non-survivors) and 88% are expected to survive (ventilated survivors).

3) Prophylaxis. Only pre-exposure vaccination is modeled for botulism, with all vaccinated individuals modeled to be fully protected against the onset of disease. Therefore, the efficacy of prophylaxis is 1.0.[8]

The tables below should be inserted after Table A-40, Injury Profile for Untreated Botulism Non-Survivors:

**Table 16. Injury Profile for Treated, Unventilated Botulism Survivors**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 2 |
| 2 | 3 |
| 3 | 2 |

**Table 17. Injury Profile for Treated, Ventilated Botulism Non-Survivors**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 2 |
| 2 | 3 |
| 3 | 4 |

**Table 18 Injury Profile for Treated, Ventilated Botulism Survivors**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 2 |
| 2 | 3 |
| 3 | 4 |
| 4 | 2 |

[8] Dembek, Smith, and Rusnak, "Botulinum Toxin," 345. Michael P. Byrne and Leonard A. Smith, "Development of Vaccines for the Prevention of Botulism," *Biochimie* 83, no. 9–10 (2000): 962.

To calculate the time at which ventilation would be required for botulism casualties, the following table and figure should be inserted after Figure A-55, Fraction of Untreated Botulism Non-Survivors Who Enter Stage 2 of Illness on Specified Day:

**Table 19. Fraction of Untreated Botulism Non-Survivors Who Enter Stage 3 of Illness on Specified Day**

| Day | Stage 3 – Untreated Non-Survivors |
|---|---|
| 1 | 0.0198 |
| 2 | 0.1206 |
| 3 | 0.1826 |
| 4 | 0.1799 |
| 5 | 0.1478 |
| 6 | 0.1105 |
| 7 | 0.0784 |
| 8 | 0.0538 |
| 9 | 0.0362 |
| 10 | 0.0241 |
| 11 | 0.0159 |
| 12 | 0.0104 |
| 13 | 0.0068 |
| 14 | 0.0045 |
| 15 | 0.0029 |
| 16 | 0.0019 |
| 17 | 0.0013 |
| 18 | 0.0008 |
| 19 | 0.0006 |
| 20 | 0.0004 |
| 21 | 0.0003 |
| > 21 | 0.0005 |

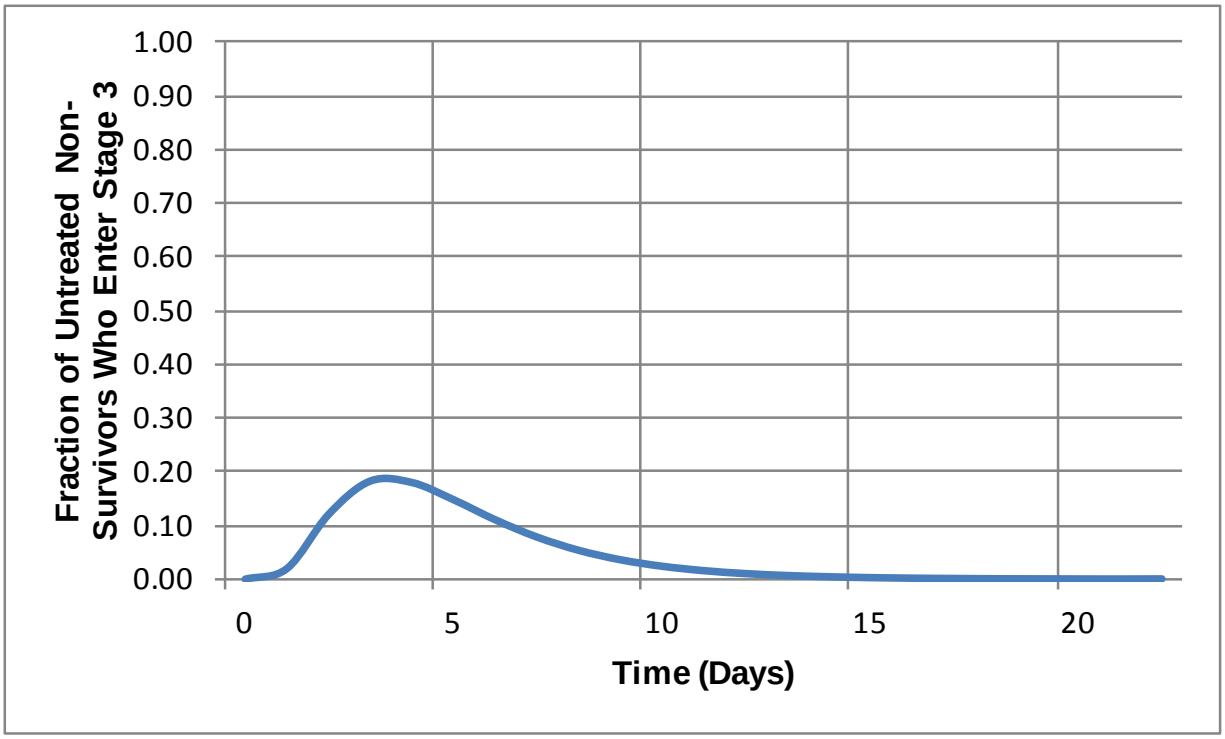


**Figure 10. Fraction of Untreated Botulism Non-Survivors Who Enter Stage 3 of Illness on Specified Day**

The following set of tables and figures should be inserted after Figure A-56 to reflect consideration of treatment in the botulism human response model.

**Table 20. Fraction of Treated, Unventilated Botulism Survivors Who Enter Stage 2 of Illness on Specified Day**

| Day | Stage 2 – Treated, Unventilated Survivors |
|---|---|
| 1 | 0 |
| 2 | 0.5000 |
| 3 | 0.2954 |
| 4 | 0.1092 |
| 5 | 0.0460 |
| 6 | 0.0218 |
| 7 | 0.0112 |
| 8 | 0.0062 |
| 9 | 0.0036 |
| 10 | 0.0022 |
| 11 | 0.0014 |
| 12 | 0.0009 |
| 13 | 0.0006 |
| 14 | 0.0004 |
| 15 | 0.0003 |
| 16 | 0.0002 |
| 17 | 0.0002 |
| 18 | 0.0001 |
| 19 | 0.0001 |
| 20 | 0.0001 |
| 21 | 0.0000 |
| > 21 | 0.0001 |

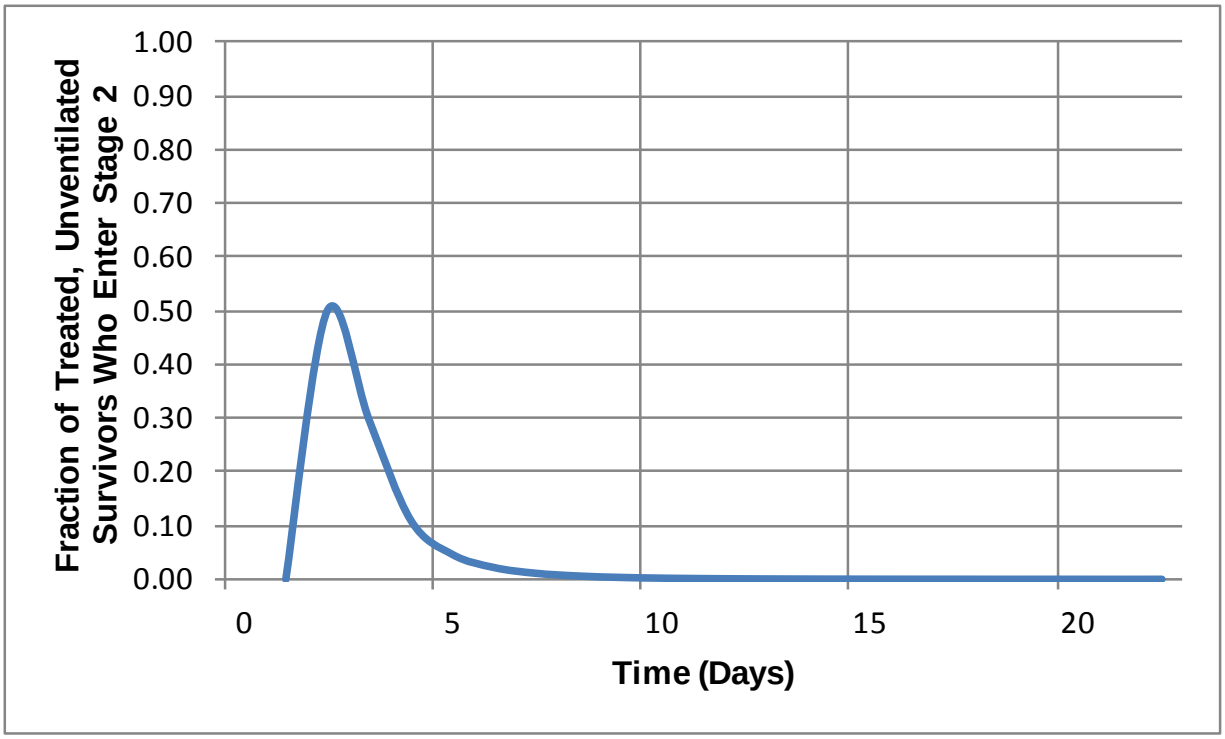


**Figure 11. Fraction of Treated, Unventilated Botulism Survivors Who Enter Stage 2 of Illness on Specified Day**

**Table 21. Fraction of Treated, Unventilated Botulism Survivors Who Return to Duty on Specified Day**

| Day | RTD – Treated, Unventilated Survivors |
|---|---|
| 278 | 0 |
| 279 | 0.5000 |
| 280 | 0.2954 |
| 281 | 0.1092 |
| 282 | 0.0460 |
| 283 | 0.0218 |
| 284 | 0.0112 |
| 285 | 0.0062 |
| 286 | 0.0036 |
| 287 | 0.0022 |
| 288 | 0.0014 |
| 289 | 0.0009 |
| 290 | 0.0006 |
| 291 | 0.0004 |
| 292 | 0.0003 |
| 293 | 0.0002 |
| 294 | 0.0002 |
| 295 | 0.0001 |
| 296 | 0.0001 |
| 297 | 0.0001 |
| 298 | 0.0000 |
| > 298 | 0.0001 |

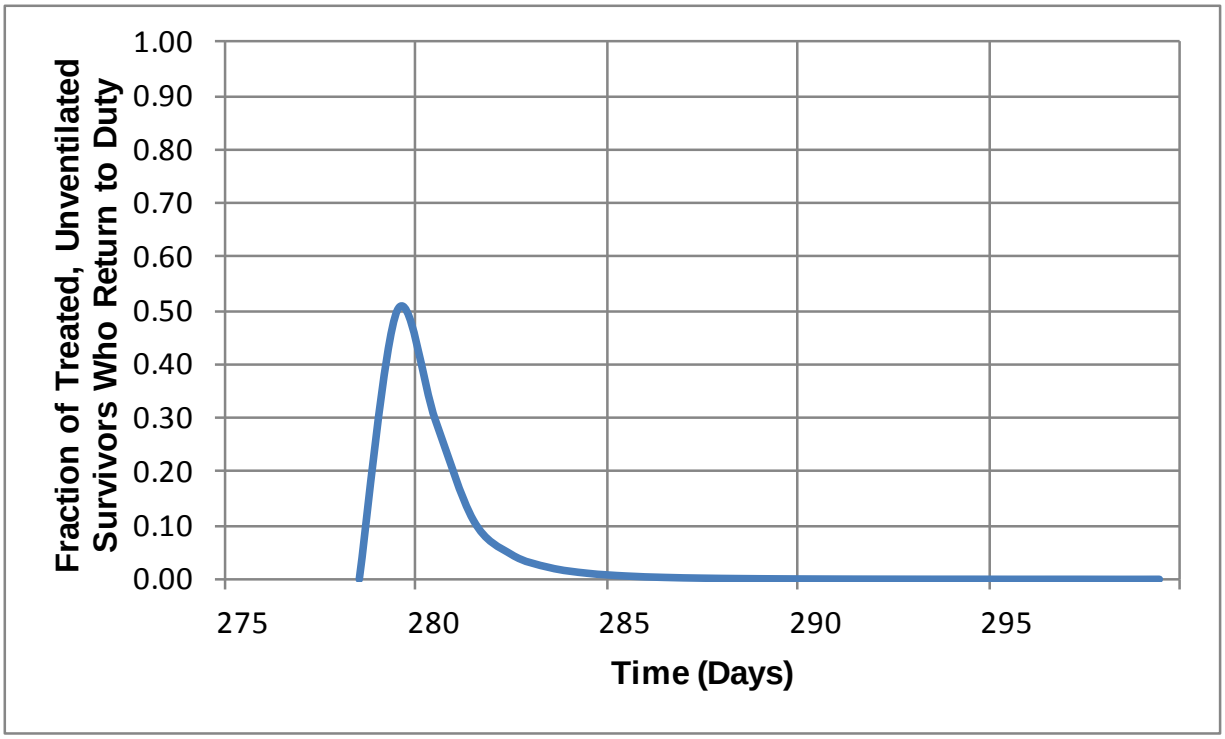


**Figure 12. Fraction of Treated, Unventilated Botulism Survivors Who Return to Duty on Specified Day**

**Table 22. Fraction of Treated, Ventilated Botulism Non-Survivors Who Enter Stage 2 of Illness on Specified Day**

| Day | Stage 2 – Treated, Ventilated Non-Survivors |
|---|---|
| 1 | 0.1580 |
| 2 | 0.3295 |
| 3 | 0.2328 |
| 4 | 0.1314 |
| 5 | 0.0693 |
| 6 | 0.0359 |
| 7 | 0.0188 |
| 8 | 0.0101 |
| 9 | 0.0056 |
| 10 | 0.0032 |
| 11 | 0.0019 |
| 12 | 0.0012 |
| 13 | 0.0008 |
| 14 | 0.0005 |
| 15 | 0.0003 |
| 16 | 0.0002 |
| 17 | 0.0002 |
| 18 | 0.0001 |
| 19 | 0.0001 |
| 20 | 0.0001 |
| 21 | 0.0001 |
| > 21 | 0.0000 |

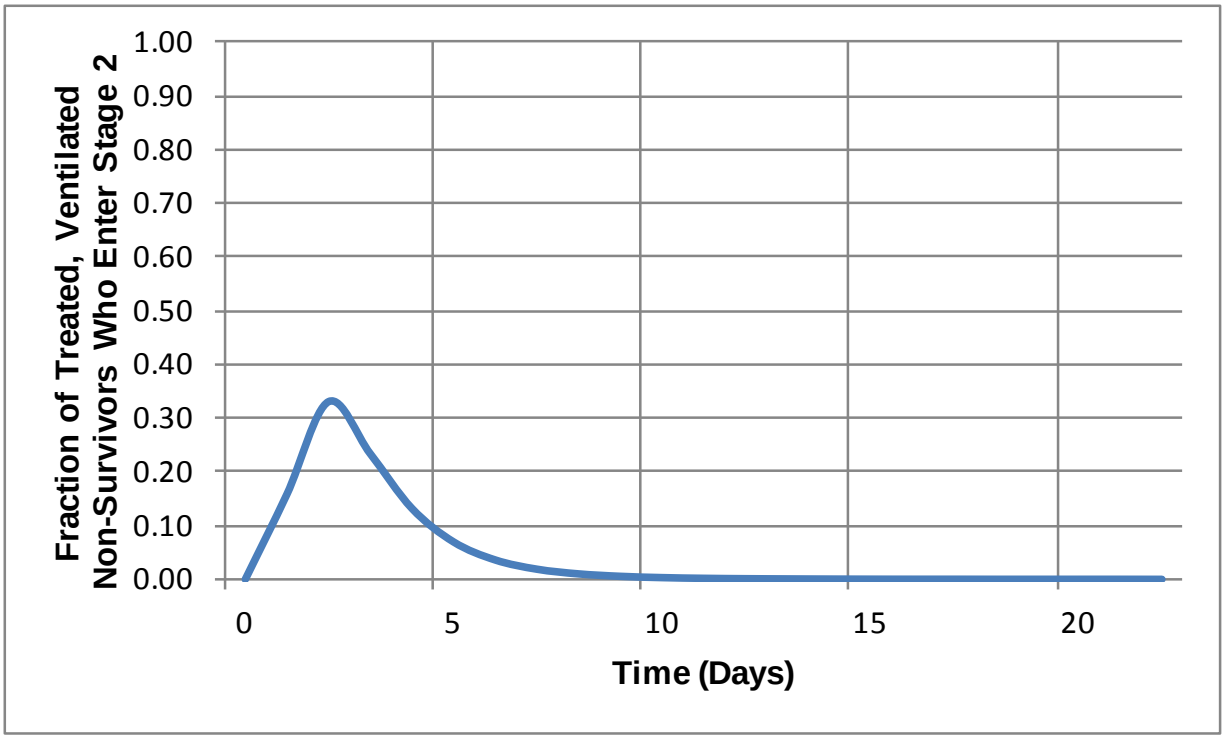


**Figure 13. Fraction of Treated, Ventilated Botulism Non-Survivors Who Enter Stage 2 of Illness on Specified Day**

**Table 23. Fraction of Treated, Ventilated Botulism Non-Survivors Who Die on Specified Day**

| Day | DOW – Treated, Ventilated Non-Survivors |
|---|---|
| 71 | 0.0198 |
| 72 | 0.1206 |
| 73 | 0.1826 |
| 74 | 0.1799 |
| 75 | 0.1478 |
| 76 | 0.1105 |
| 77 | 0.0784 |
| 78 | 0.0538 |
| 79 | 0.0362 |
| 80 | 0.0241 |
| 81 | 0.0159 |
| 82 | 0.0104 |
| 83 | 0.0068 |
| 84 | 0.0045 |
| 85 | 0.0029 |
| 86 | 0.0019 |
| 87 | 0.0013 |
| 88 | 0.0008 |
| 89 | 0.0006 |
| 90 | 0.0004 |
| 91 | 0.0003 |
| > 91 | 0.0005 |

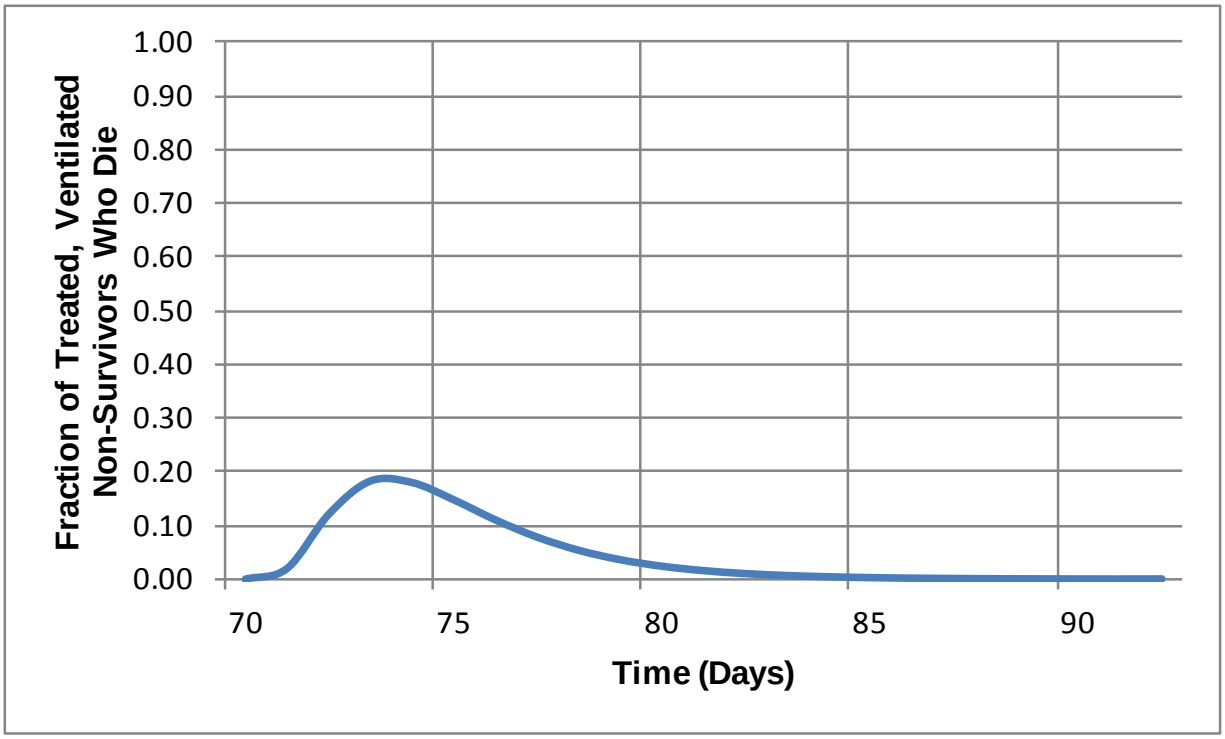


**Figure 14. Fraction of Treated, Ventilated Botulism Non-Survivors Who Die on Specified Day**

**Table 24. Fraction of Treated, Ventilated Botulism Survivors Who Enter Stage 2 of Illness on Specified Day**

| Day | Stage 2 – Treated, Ventilated Survivors |
|---|---|
| 1 | 0.1580 |
| 2 | 0.3295 |
| 3 | 0.2328 |
| 4 | 0.1314 |
| 5 | 0.0693 |
| 6 | 0.0359 |
| 7 | 0.0188 |
| 8 | 0.0101 |
| 9 | 0.0056 |
| 10 | 0.0032 |
| 11 | 0.0019 |
| 12 | 0.0012 |
| 13 | 0.0008 |
| 14 | 0.0005 |
| 15 | 0.0003 |
| 16 | 0.0002 |
| 17 | 0.0002 |
| 18 | 0.0001 |
| 19 | 0.0001 |
| 20 | 0.0001 |
| 21 | 0.0001 |
| > 21 | 0.0000 |

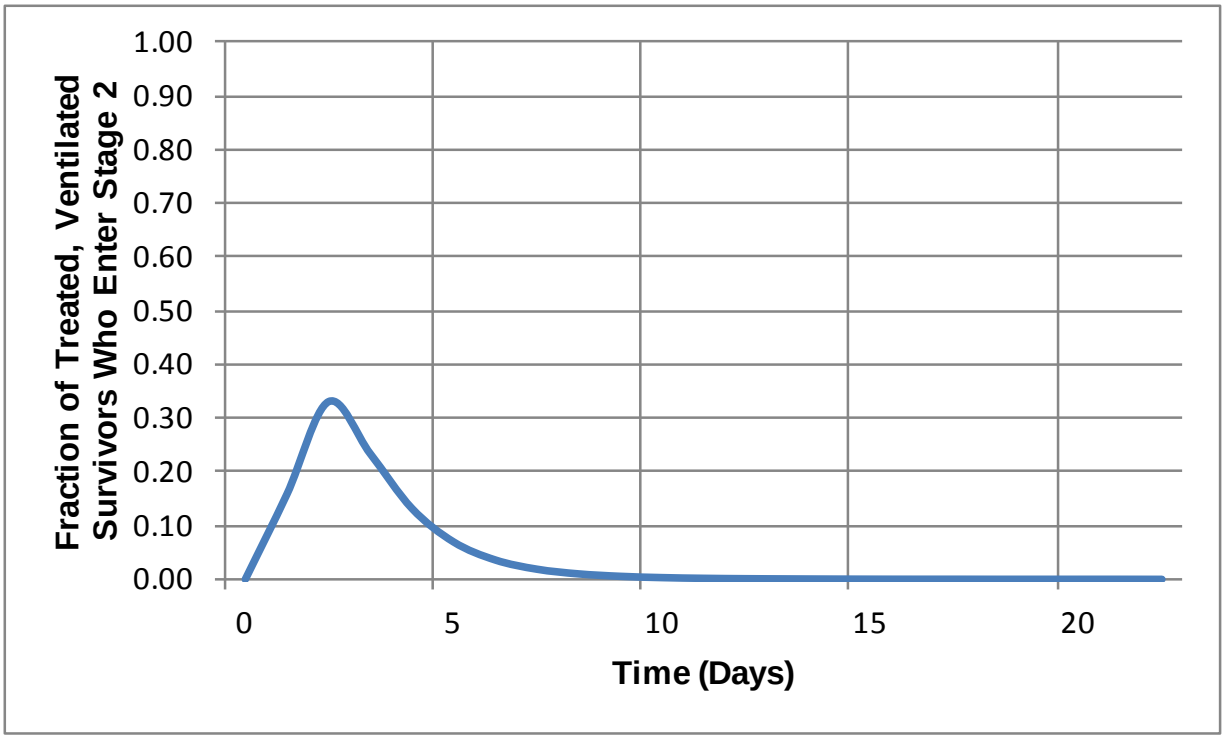


**Figure 15. Fraction of Treated, Ventilated Botulism Survivors Who Enter Stage 2 of Illness on Specified Day**

**Table 25. Fraction of Treated, Ventilated Botulism Survivors Who Enter Stage 4 of Illness on Specified Day and Remain Convalescent**

| Day | Stage 4/Convalescence – Treated, Ventilated Survivors |
|---|---|
| 71 | 0.0198 |
| 72 | 0.1206 |
| 73 | 0.1826 |
| 74 | 0.1799 |
| 75 | 0.1478 |
| 76 | 0.1105 |
| 77 | 0.0784 |
| 78 | 0.0538 |
| 79 | 0.0362 |
| 80 | 0.0241 |
| 81 | 0.0159 |
| 82 | 0.0104 |
| 83 | 0.0068 |
| 84 | 0.0045 |
| 85 | 0.0029 |
| 86 | 0.0019 |
| 87 | 0.0013 |
| 88 | 0.0008 |
| 89 | 0.0006 |
| 90 | 0.0004 |
| 91 | 0.0003 |
| > 91 | 0.0005 |

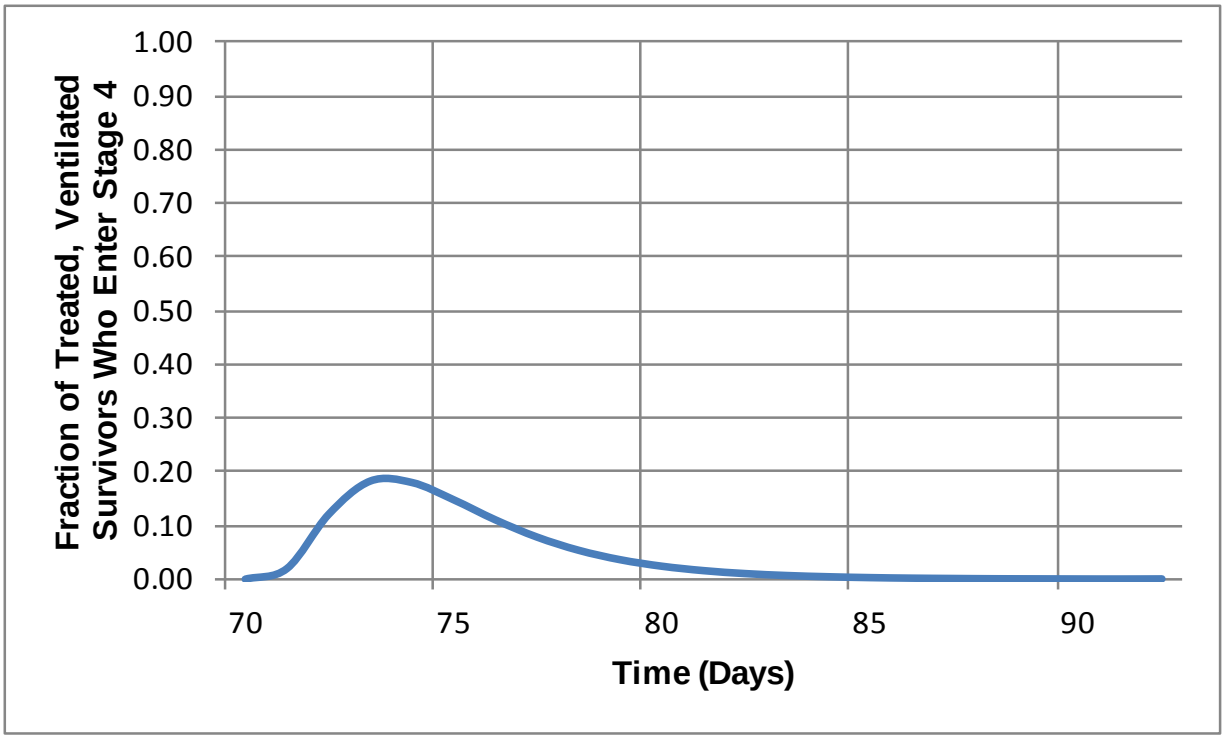


**Figure 16. Fraction of Treated, Ventilated Botulism Survivors Who Enter Stage 4 of Illness on Specified Day and Remain Convalescent**

### c. A108.3 VEE Parameters and Lookup Tables

There are no medical countermeasures or specific treatments for VEE that would alter any of the component submodels of VEE human response; the parameters and lookup tables now in *AMedP-8(C)* will not change. However, because the lethality of VEE is 0%, all VEE patients will return to duty. To account for this, the following table and figure should be added after Figure A-57:

**Table 26. Fraction of People Ill with VEE Who Return to Duty on Specified Day**

| Day | RTD |
|---|---|
| 1 | 0.0000 |
| 2 | 0.0000 |
| 3 | 0.0000 |
| 4 | 0.0002 |
| 5 | 0.0037 |
| 6 | 0.0175 |
| 7 | 0.0435 |
| 8 | 0.0735 |
| 9 | 0.0972 |
| 10 | 0.1088 |
| 11 | 0.1086 |
| 12 | 0.1000 |
| 13 | 0.0871 |
| 14 | 0.0729 |
| 15 | 0.0595 |
| 16 | 0.0477 |
| 17 | 0.0378 |
| 18 | 0.0297 |
| 19 | 0.0233 |
| 20 | 0.0183 |
| 21 | 0.0143 |
| 22 | 0.0113 |
| 23 | 0.0089 |
| 24 | 0.0070 |
| 25 | 0.0056 |
| 26 | 0.0044 |
| 27 | 0.0035 |
| 28 | 0.0028 |
| 29 | 0.0023 |
| 30 | 0.0018 |
| 31 | 0.0015 |
| 32 | 0.0012 |
| 33 | 0.0010 |
| 34 | 0.0008 |
| 35 | 0.0007 |
| >35 | 0.0036 |

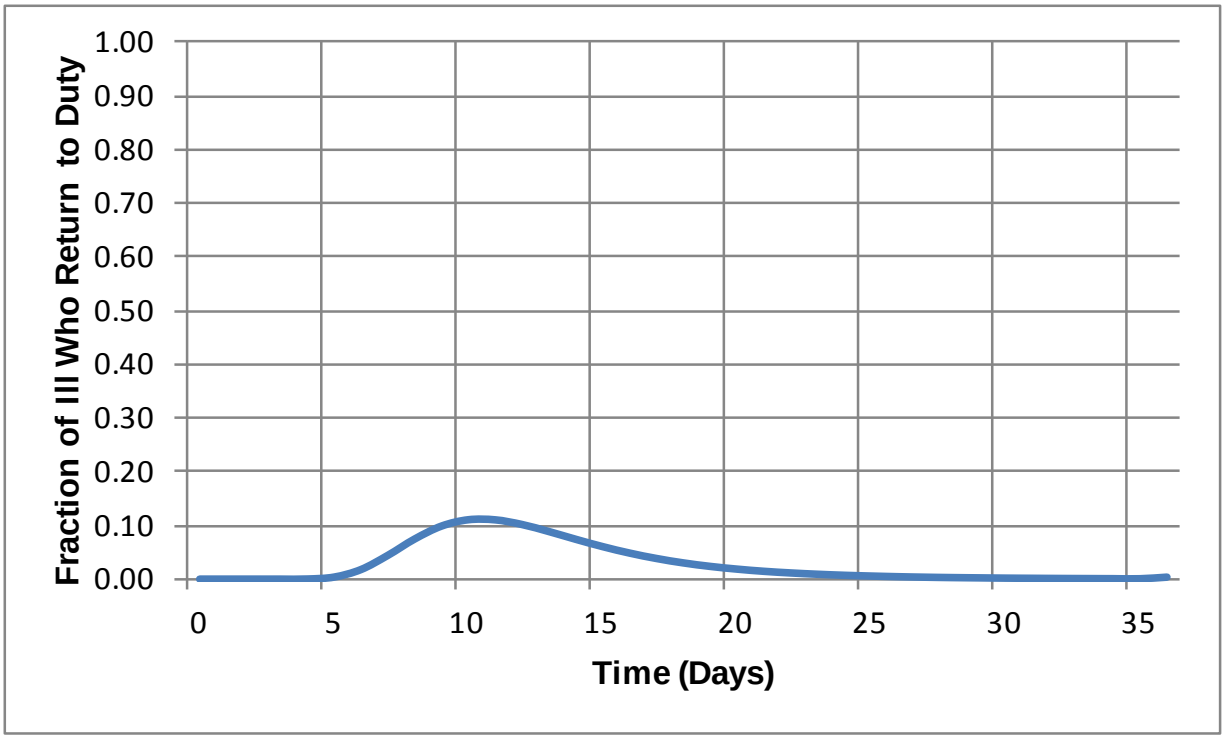


**Figure 17. Fraction of People Ill with VEE Who Return to Duty on Specified Day**

### d. A108.4 Brucellosis Parameters and Lookup Tables

The following paragraphs describe the parameters and lookup tables needed to estimate casualties from brucellosis, with and without consideration of medical care. They should be inserted after Section A108.3, VEE Parameters and Lookup Tables.

1. Infectivity. The probability of becoming ill with brucellosis is modeled as a log-probit function with a probit slope of 2.58 probits/log(dose) and a median infectious dose ($ID_{50}$) of 949 organisms.[9] The infective dose of brucellosis can, therefore, be expressed as a random variable with a lognormal distribution whose cumulative distribution (CDF) is:

[9] Derived from data in Sanford S. Elberg et al., "Immunization against *Brucella* Infection IV: Response of Monkeys to Injection of a Streptomycin-Dependent Strain of *Brucella melitensis*," *Journal of Bacteriology* 69, no. 6 (June 1955): 643–48; Sanford S. Elberg and W. K. Faunce, Jr., "Immunization against *Brucella* Infection 8. The Response of *Cynomolgus philippinensis*, Guinea-Pigs and Pregnant Goats to Infection by the Rev I Strain of *Brucella melitensis*," *Bulletin of the World Health Organization* 26, no. 3 (1962): 421–36; Sanford S. Elberg and W.K. Faunce, Jr., "Immunization against *Brucella* Infection 10. The Relative Immunogenicity of *Brucella abortus* Strain 19-BA and *Brucella melitensis* Strain Rev I in *Cynomolgus philippinensis*," *Bulletin of the World Health Organization* 30, no. 5 (1964): 693–99; and M. G. Mense et al., "Pathologic Changes Associated with Brucellosis Experimentally Induced by Aerosol Exposure in Rhesus Macaques (*Macaca mulatta*)," *American Journal of Veterinary Research* 66, no. 5 (May 2004): 644–52.

$$p_{\text{E-Bruc}}(\mathrm{d}_n) = \frac{1}{2} + \frac{1}{2} erf\left[\frac{\ln(\mathrm{d}_n) - \mu}{\sigma\sqrt{2}}\right]$$

where:

*n* is the index number of the icon,

$p_{\text{E-Bruc}}(\mathrm{d}_n)$ is the fraction of persons exposed to a dose d of *Brucella* organisms at Icon *n* who become ill (exposed and infected),

$\mathrm{d}_n$ is the dose of *Brucella* at Icon *n* [organisms],

μ is the mean of the variable's natural logarithm [$= \ln(\mathrm{ID}_{50} = \ln(949 \text{ organisms}) = 6.86$],

m is the probit slope [=2.58 probits/log(dose)]

σ is the standard deviation of the variable's natural logarithm [$= \mathrm{e}^{1/\mathrm{m}} = \mathrm{e}^{1/2.58} = 1.47$], and

*erf* is the error function where $erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2}\, dt.$

Based on this distribution, Figure A-58 illustrates the probability of becoming ill from the dose of *Brucella* inhaled.

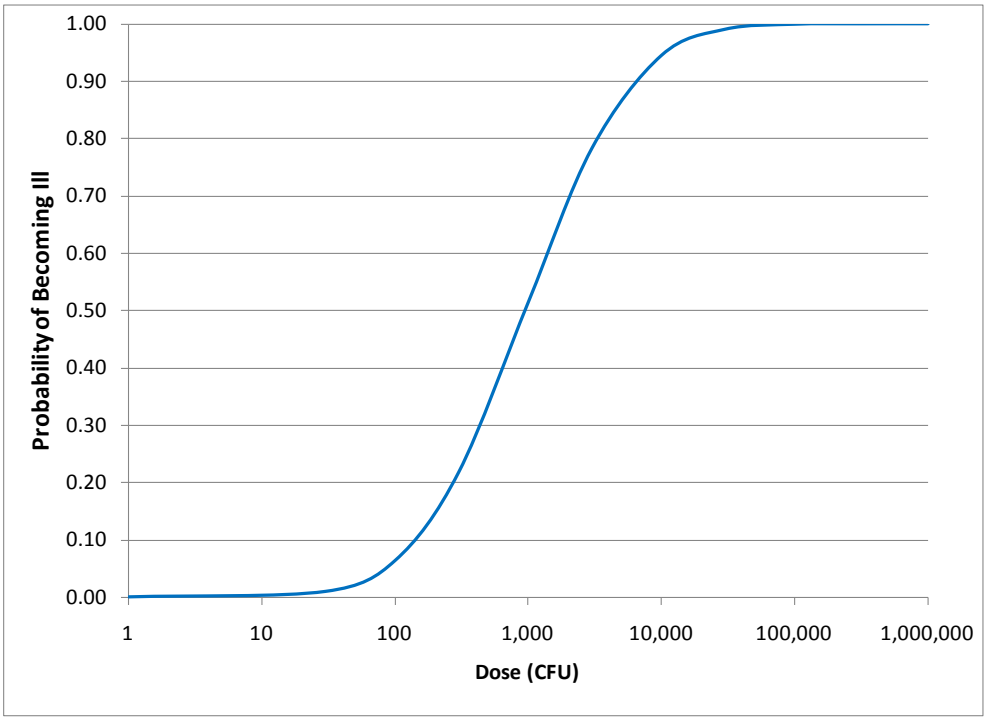


**Figure 18. Dose-Related Probability of Becoming Ill with Brucellosis**

2. Lethality. For brucellosis, lethality is assumed to be 0%. Therefore $p_{\text{f-Bruc}}(d_n) = 0$ for all values of $d_n$, and there are no resulting DOW casualties.[10]

3. Injury Profile. Brucellosis has two distinct clinical presentations, abrupt and insidious onset, characterized by differences in the severity of illness in the initial stage. Half of brucellosis cases are assumed to be of the abrupt onset type, and half are assumed to be of the insidious onset type. Incubation period is the same for both types, so the time at which all brucellosis cases enter Stage 1 of illness is independent of type. Only insidious onset cases will enter Stage 2 of illness.

**Table 27. Injury Profile for Abrupt Onset Brucellosis**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 3 |

**Table 28. Injury Profile for Insidious Onset Brucellosis**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 1 |
| 2 | 3 |

[10] Since the untreated case fatality rates are reportedly no greater than 6% (see the first five references in this footnote) and fewer than 10% of brucellosis cases are reported (see final two references), the percentage of individuals that die from brucellosis is likely less than 0.6% of the number who actually become ill. P. W. Bassett-Smith, "Mediterranean or Undulant Fever," *British Medical Journal* 2, no. 3228 (1922): 902–5; Alice C. Evans, "Undulant Fever," *American Journal of Nursing* 30, no. 11 (1930): 1349–52; Louise Hostman, "Undulant Fever," *American Journal of Nursing* 34, no. 8 (1934): 753–58; Bossi et al., "Bichat Guidelines for the Clinical Management of Brucellosis"; Pablo Yagupsky and Ellen Jo Baron,"Laboratory Exposures to Brucellae and Implications for Bioterrorism,"*Emerging Infectious Diseases* 11, no. 8 (2005): 1180–85; Robert I. Wise, "Brucellosis in the United States: Past, Present, and Future," *Journal of American Medical Association* 244, no. 20 (1980): 2318; and Sascha Al Dahouk et al., "Changing Epidemiology of Human Brucellosis, Germany, 1962–2005,"*Emerging Infectious Diseases* 13, no. 2 (2007): 1898.

**Table 29. Fraction of People Ill with Brucellosis (Abrupt or Insidious Onset) Who Enter Stage 1 of Illness on Specified Day**

| Day | Stage 1 – Abrupt or Insidious Onset | Day | Stage 1 – Abrupt or Insidious Onset |
|---|---|---|---|
| 1 | 0.0006 | 63 | 0.0712 |
| 2 | 0.0015 | 70 | 0.0661 |
| 3 | 0.0021 | 77 | 0.0602 |
| 4 | 0.0027 | 84 | 0.0538 |
| 5 | 0.0033 | 91 | 0.0473 |
| 6 | 0.0038 | 98 | 0.0409 |
| 7 | 0.0042 | 105 | 0.0348 |
| 8 | 0.0047 | 112 | 0.0293 |
| 9 | 0.0051 | 119 | 0.0242 |
| 10 | 0.0055 | 126 | 0.0198 |
| 11 | 0.0058 | 133 | 0.0160 |
| 12 | 0.0062 | 140 | 0.0128 |
| 13 | 0.0065 | 147 | 0.0101 |
| 14 | 0.0069 | 154 | 0.0079 |
| 15 | 0.0072 | 161 | 0.0061 |
| 16 | 0.0075 | 168 | 0.0046 |
| 17 | 0.0077 | 175 | 0.0035 |
| 18 | 0.0080 | 182 | 0.0026 |
| 19 | 0.0083 | 189 | 0.0019 |
| 20 | 0.0085 | 196 | 0.0014 |
| 21 | 0.0087 | 203 | 0.0010 |
| 22 | 0.0089 | 210 | 0.0007 |
| 23 | 0.0091 | 217 | 0.0005 |
| 24 | 0.0093 | 224 | 0.0004 |
| 25 | 0.0095 | 231 | 0.0003 |
| 26 | 0.0097 | 238 | 0.0002 |
| 27 | 0.0098 | 245 | 0.0001 |
| 28 | 0.0100 | 252 | 0.0001 |
| 35 | 0.0731 | 259 | 0.0001 |
| 42 | 0.0764 | 266 | 0.0000 |
| 49 | 0.0768 | 273 | 0.0000 |
| 56 | 0.0749 | 280 | 0.0000 |

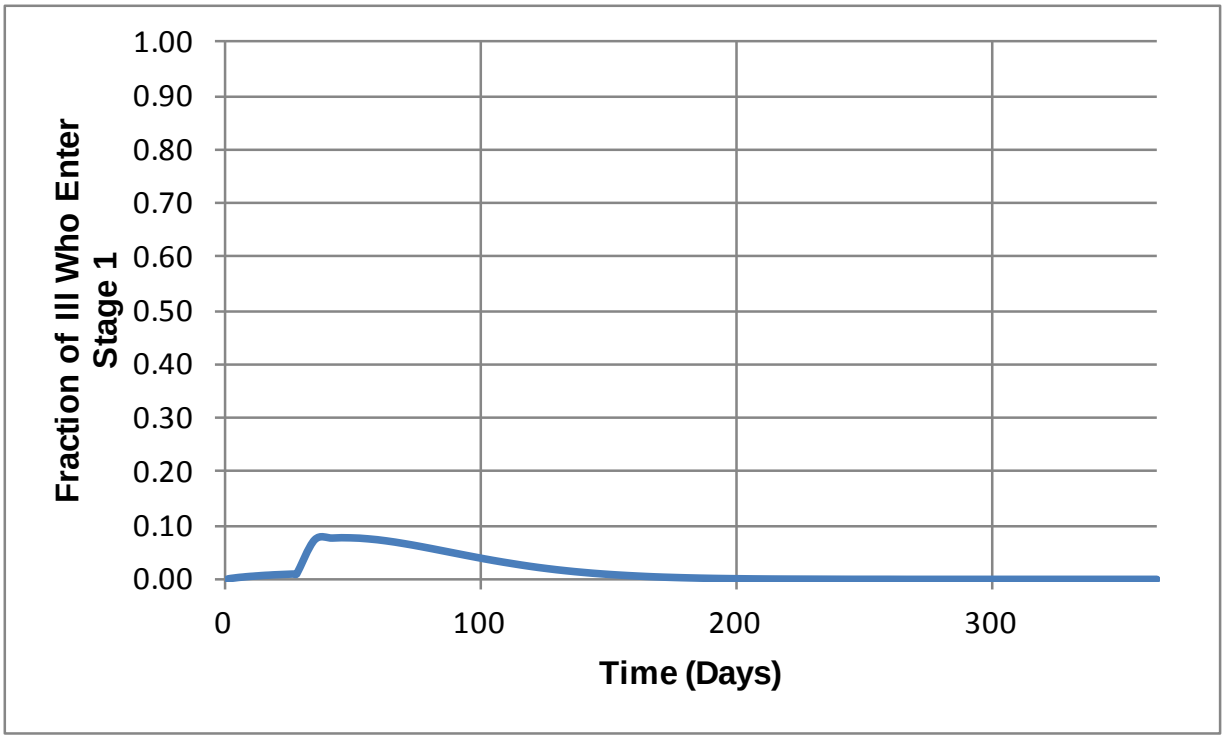


**Figure 19. Fraction of People Ill with Brucellosis (Abrupt or Insidious Onset) Who Have Entered Stage 1 of Illness by Specified Day**

**Table 30. Fraction of Untreated People Ill with Insidious Onset Brucellosis Who Enter Stage 2 of Illness on Specified Day**

| Day | Stage 2 – Untreated Insidious Onset | Day | Stage 2 – Untreated Insidious Onset |
|---|---|---|---|
| 1 | 0.0000 | 105 | 0.0503 |
| 2 | 0.0001 | 112 | 0.0463 |
| 3 | 0.0001 | 119 | 0.0421 |
| 4 | 0.0002 | 126 | 0.0377 |
| 5 | 0.0004 | 133 | 0.0336 |
| 6 | 0.0005 | 140 | 0.0297 |
| 7 | 0.0007 | 147 | 0.0258 |
| 8 | 0.0008 | 154 | 0.0227 |
| 9 | 0.0010 | 161 | 0.0196 |
| 10 | 0.0011 | 168 | 0.0166 |
| 11 | 0.0014 | 175 | 0.0143 |
| 12 | 0.0014 | 182 | 0.0120 |
| 13 | 0.0016 | 189 | 0.0101 |
| 14 | 0.0019 | 196 | 0.0085 |
| 15 | 0.0020 | 203 | 0.0069 |
| 16 | 0.0022 | 210 | 0.0059 |
| 17 | 0.0023 | 217 | 0.0050 |
| 18 | 0.0027 | 224 | 0.0041 |
| 19 | 0.0027 | 231 | 0.0036 |
| 20 | 0.0030 | 238 | 0.0028 |
| 21 | 0.0031 | 245 | 0.0023 |
| 22 | 0.0032 | 252 | 0.0019 |
| 23 | 0.0035 | 259 | 0.0015 |
| 24 | 0.0037 | 266 | 0.0013 |
| 25 | 0.0039 | 273 | 0.0011 |
| 26 | 0.0041 | 280 | 0.0009 |
| 27 | 0.0043 | 287 | 0.0007 |
| 28 | 0.0045 | 294 | 0.0006 |
| 35 | 0.0361 | 301 | 0.0005 |
| 42 | 0.0439 | 308 | 0.0004 |
| 49 | 0.0501 | 315 | 0.0003 |
| 56 | 0.0554 | 322 | 0.0003 |
| 63 | 0.0580 | 329 | 0.0003 |
| 70 | 0.0598 | 336 | 0.0002 |
| 77 | 0.0600 | 343 | 0.0001 |
| 84 | 0.0589 | 350 | 0.0001 |
| 91 | 0.0565 | 357 | 0.0001 |
| 98 | 0.0544 | 364 | 0.0001 |

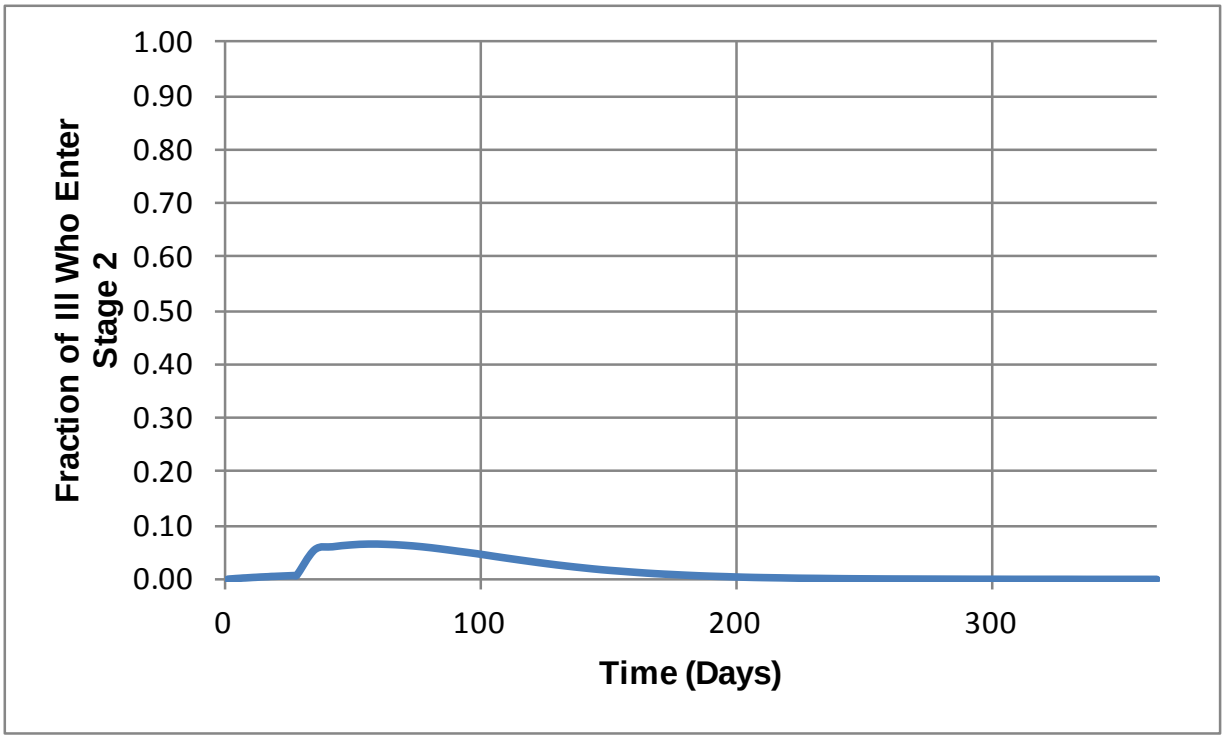


**Figure 20. Fraction of Untreated People Ill with Insidious Onset Brucellosis Who Have Entered Stage 2 of Illness by Specified Day**

**Table 31. Fraction of People Ill with Brucellosis (Abrupt or Insidious Onset) Who Enter Convalescence on Specified Day with Treatment Initiated in Stage 1**

| Day | Convalescence – Treated Abrupt or Insidious Onset | Day | Convalescence – Treated Abrupt or Insidious Onset |
|---|---|---|---|
| 15 | 0.0006 | 77 | 0.0712 |
| 16 | 0.0015 | 84 | 0.0661 |
| 17 | 0.0021 | 91 | 0.0602 |
| 18 | 0.0027 | 98 | 0.0538 |
| 19 | 0.0033 | 105 | 0.0473 |
| 20 | 0.0038 | 112 | 0.0409 |
| 21 | 0.0042 | 119 | 0.0348 |
| 22 | 0.0047 | 126 | 0.0293 |
| 23 | 0.0051 | 133 | 0.0242 |
| 24 | 0.0055 | 140 | 0.0198 |
| 25 | 0.0058 | 147 | 0.0160 |
| 26 | 0.0062 | 154 | 0.0128 |
| 27 | 0.0065 | 161 | 0.0101 |
| 28 | 0.0069 | 168 | 0.0079 |
| 29 | 0.0072 | 175 | 0.0061 |
| 30 | 0.0075 | 182 | 0.0046 |
| 31 | 0.0077 | 189 | 0.0035 |
| 32 | 0.0080 | 196 | 0.0026 |
| 33 | 0.0083 | 203 | 0.0019 |
| 34 | 0.0085 | 210 | 0.0014 |
| 35 | 0.0087 | 217 | 0.0010 |
| 36 | 0.0089 | 224 | 0.0007 |
| 37 | 0.0091 | 231 | 0.0005 |
| 38 | 0.0093 | 238 | 0.0004 |
| 39 | 0.0095 | 245 | 0.0003 |
| 40 | 0.0097 | 252 | 0.0002 |
| 41 | 0.0098 | 259 | 0.0001 |
| 42 | 0.0100 | 266 | 0.0001 |
| 49 | 0.0731 | 273 | 0.0001 |
| 56 | 0.0764 | 280 | 0.0000 |
| 63 | 0.0768 | 287 | 0.0000 |
| 70 | 0.0749 | 294 | 0.0000 |

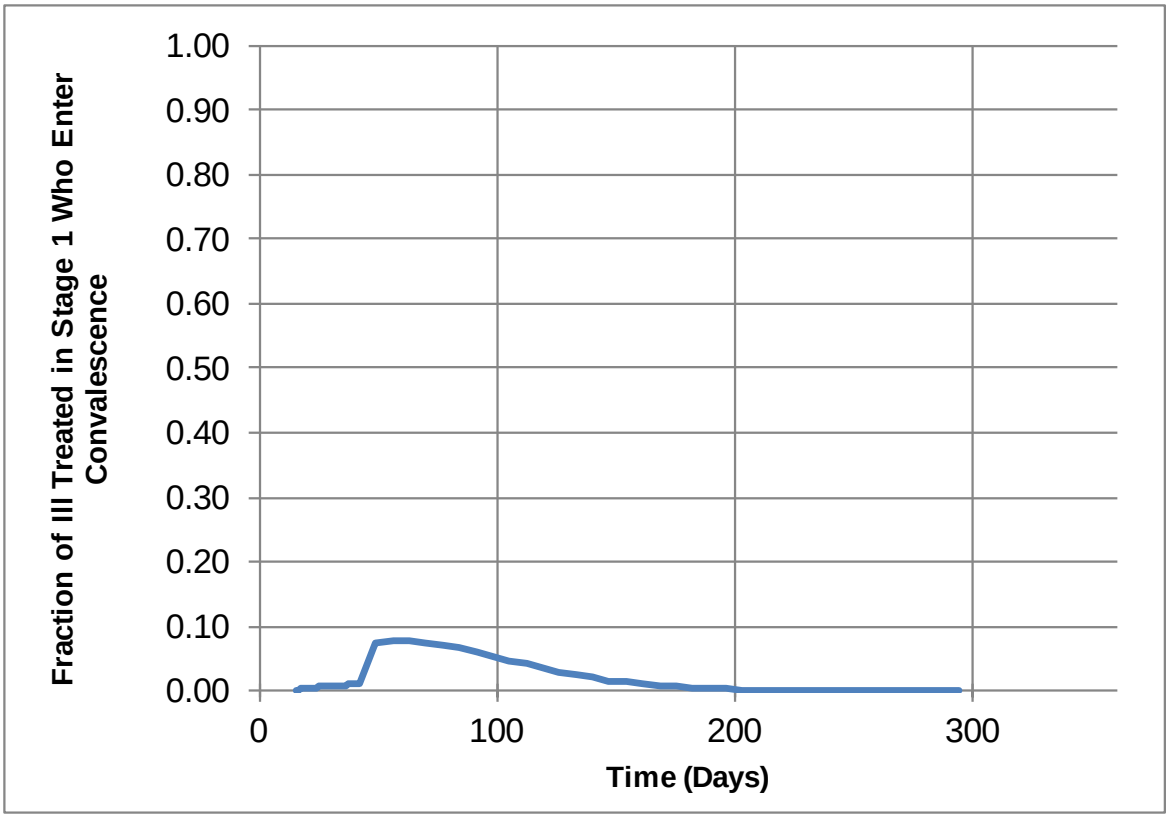


**Figure 21. Fraction of People Ill with Brucellosis (Abrupt or Insidious Onset) Who Enter Convalescence by Specified Day with Treatment Initiated in Stage 1**

**Table 32. Fraction of People Ill with Insidious Onset Brucellosis Who Enter Convalescence on Specified Day with Treatment Initiated in Stage 2**

| Day | Convalescence – Insidious Onset Treated in Stage 2 | Day | Convalescence – Insidious Onset Treated in Stage 2 |
|---|---|---|---|
| 15 | 0.0000 | 119 | 0.0503 |
| 16 | 0.0001 | 126 | 0.0463 |
| 17 | 0.0001 | 133 | 0.0421 |
| 18 | 0.0002 | 140 | 0.0377 |
| 19 | 0.0004 | 147 | 0.0336 |
| 20 | 0.0005 | 154 | 0.0297 |
| 21 | 0.0007 | 161 | 0.0258 |
| 22 | 0.0008 | 168 | 0.0227 |
| 23 | 0.0010 | 175 | 0.0196 |
| 24 | 0.0011 | 182 | 0.0166 |
| 25 | 0.0014 | 189 | 0.0143 |
| 26 | 0.0014 | 196 | 0.0120 |
| 27 | 0.0016 | 203 | 0.0101 |
| 28 | 0.0019 | 210 | 0.0085 |
| 29 | 0.0020 | 217 | 0.0069 |
| 30 | 0.0022 | 224 | 0.0059 |
| 31 | 0.0023 | 231 | 0.0050 |
| 32 | 0.0027 | 238 | 0.0041 |
| 33 | 0.0027 | 245 | 0.0036 |
| 34 | 0.0030 | 252 | 0.0028 |
| 35 | 0.0031 | 259 | 0.0023 |
| 36 | 0.0032 | 266 | 0.0019 |
| 37 | 0.0035 | 273 | 0.0015 |
| 38 | 0.0037 | 280 | 0.0013 |
| 39 | 0.0039 | 287 | 0.0011 |
| 40 | 0.0041 | 294 | 0.0009 |
| 41 | 0.0043 | 301 | 0.0007 |
| 42 | 0.0045 | 308 | 0.0006 |
| 49 | 0.0361 | 315 | 0.0005 |
| 56 | 0.0439 | 322 | 0.0004 |
| 63 | 0.0501 | 329 | 0.0003 |
| 70 | 0.0554 | 336 | 0.0003 |
| 77 | 0.0580 | 343 | 0.0003 |
| 84 | 0.0598 | 350 | 0.0002 |
| 91 | 0.0600 | 357 | 0.0001 |
| 98 | 0.0589 | 364 | 0.0001 |
| 105 | 0.0565 | 373 | 0.0001 |
| 112 | 0.0544 | 380 | 0.0001 |

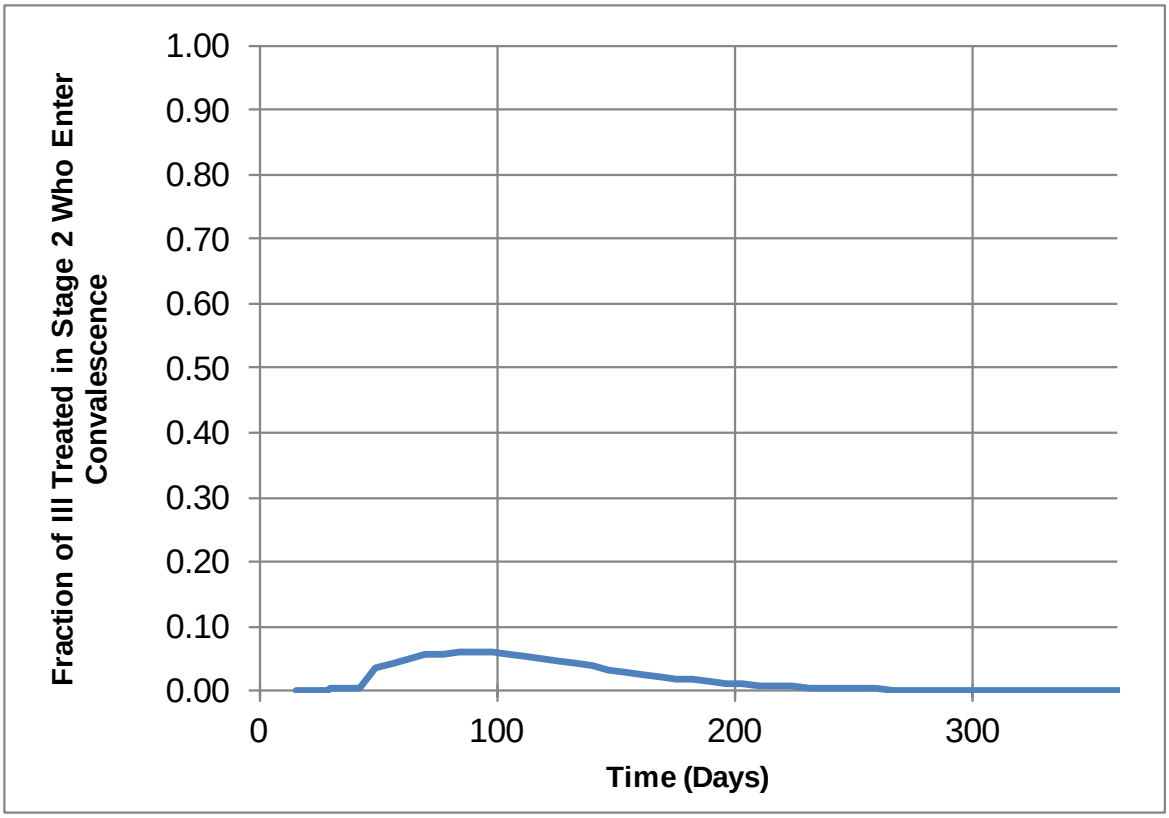


**Figure 22. Fraction of People Ill with Insidious Onset Brucellosis Who Enter Convalescence by Specified Day with Treatment Initiated in Stage 2**

### e. A108.5 Glanders Parameters and Lookup Tables

The following paragraphs describe the parameters and lookup tables needed to estimate casualties from glanders, with and without consideration of medical care. They should be inserted after Section A108.4, Brucellosis Parameters and Lookup Tables.

1. Infectivity. The probability of becoming ill with glanders is modeled as a log-probit function with a probit slope of 1.93 probits/log(dose) and a median infectious dose ($ID_{50}$) of 24.5 CFU.[11] The infective dose for glanders can, therefore, be expressed as a random variable with a lognormal distribution whose CDF is:

$$p_{\text{E-Glan}}(\mathrm{d}_n) = \frac{1}{2} + \frac{1}{2} erf\left[\frac{\ln(\mathrm{d}_n) - \mu}{\sigma\sqrt{2}}\right]$$

[11] George H. Anno et al., *Biological Agent Exposure and Casualty Estimation: AMedP-8 (Biological) Methods Report*, GS-35F-4923H (Fairfax, VA: General Dynamics Advanced Information Systems, May 2005).

where:

*n* is the index number of the icon,

$p_{\text{E-Glan}}(d_n)$ is the fraction of persons exposed to a dose d of *Burkholderia mallei*at Icon *n* who become ill (exposed and infected),

$d_n$ is the dose of *Burkholderia mallei*[CFU],

μ is the mean of the variable's natural logarithm [$= \ln(ID_{50} = \ln(24.5\ \text{CFU}) = 3.20$],

m is the probit slope [= 1.93 probits/log(dose)],

σ is the standard deviation of the variable's natural logarithm [$= e^{1/m} = e^{1/1.93} = 1.68$], and

*erf* is the error function where $erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2}\, dt.$

Figure A-62 illustrates the probability of becoming ill from the dose of *Burkholderia mallei* inhaled.

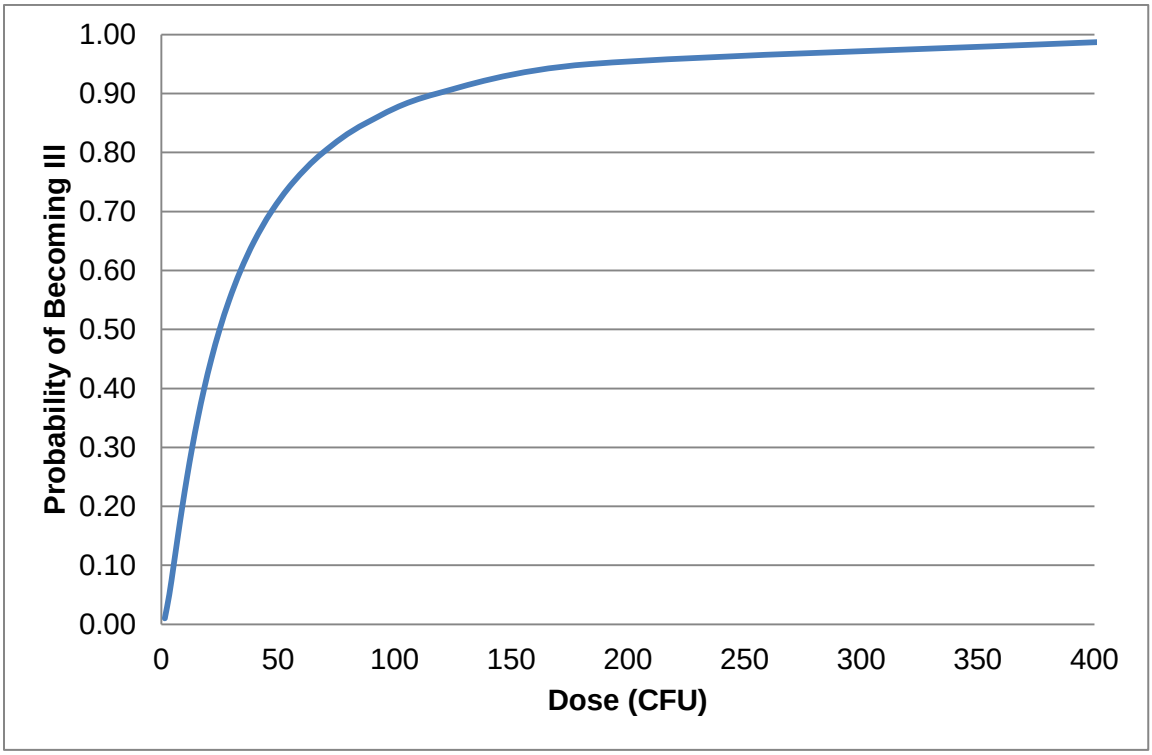


**Figure 23. Dose-Related Probability of Becoming Ill with Glanders**

2. Lethality. The untreated case fatality rate for individuals ill with glanders is approximately 70%.[12] A lethality rate of 70% will, therefore, be modeled for glanders, so $p_{\text{f-Glan}}(d_n) = 0.70 * p_{\text{E-Glan}}(d_n)$. With treatment, glanders is essentially nonfatal, so a lethality rate of 0 is modeled and $p_{\text{f-Glan}}(d_n) = 0$.

**Table 33. Untreated Injury Profile for Glanders Survivors**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 2 |

**Table 34. Untreated Injury Profile for Glanders Non-Survivors**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |

**Table 35. Treated Injury Profile for Glanders Survivors**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 2 |
| 2 | 4 |
| 3 | 2 |

[12] Derived from data in John Elliotson, "On the Glanders in the Human Subject," *Journal of the Royal Society of Medicine* 16, Pt. 1 (1831): 171–218; Clement Hamerton, "Cases of Acute Glanders in the Human Subject, Terminating Fatally," *Dublin Journal of Medical Science* 23, no. 3 (1843); W. I. Cox, "Case of Acute Glanders in the Human Subject: With Remarks,"*British Medical Journal* 2, no. 66 (1854): 309–12; Frederick Mason, "Case of Glanders in Man," *Association Medical Journal* 4, no. 168 (1856): 232–34; J. Clark Stewart, "Pyæmic Glanders in the Human Subject: Report of a Recent Case of Laboratory Origin Terminating in Recovery,"*Annals of Surgery* 40, no. 1 (1904): 109–13; George Dougall Robins, *A Study of Chronic Glanders in Man with Report of a Case: Analysis of 156 Cases Collected from the Literature and an Appendix of the Incidence of Equine and Human Glanders in Canada* 2, no. 1, Studies from the Royal Victoria Hospital Montreal (Montreal: Montreal Guertin Printing Co., 1906); James Taft Pilcher, "Glanders in the Human Subject,"*Annals of Surgery* 45, no. 3 (1907): 444–52; William Hunting, *Glanders: A Clinical Treatise*(London: H. & W. Brown, 1908); Julius M.Bernstein and E. Rock Carling,"Observations on Human Glanders,"*British Medical Journal* 1, no. 2510 (1909): 319–25; I.Sobol, "A Case of Chronic Nasal Glanders," *Acta Oto-Laryngologica* 18, no. 4 (1933): 500–9; J. F. Burgess, "Chronic Glanders," *Canadian Medical Association Journal* 34, no. 3 (1936): 258–62; and A. A. Herold and C. B. Erickson, "Human Glanders: Case Report,"*Southern Medical Journal* 31, no. 9 (1938): 1022.

**Table 36. Fraction of People Ill with Glanders Who Enter Stage 1 of Illness on Specified Day**

| Day | Stage 1 | Day | Stage 1 |
|---|---|---|---|
| 1 | 0.0897 | 35 | 0.0171 |
| 2 | 0.1467 | 42 | 0.0100 |
| 3 | 0.1258 | 49 | 0.0062 |
| 4 | 0.1006 | 56 | 0.0041 |
| 5 | 0.0801 | 63 | 0.0028 |
| 6 | 0.0643 | 70 | 0.0019 |
| 7 | 0.0522 | 77 | 0.0014 |
| 8 | 0.0429 | 84 | 0.0010 |
| 9 | 0.0357 | 91 | 0.0008 |
| 10 | 0.0300 | 98 | 0.0006 |
| 11 | 0.0254 | 105 | 0.0005 |
| 12 | 0.0217 | 112 | 0.0004 |
| 13 | 0.0186 | 119 | 0.0003 |
| 14 | 0.0161 | 126 | 0.0002 |
| 15 | 0.0140 | 133 | 0.0002 |
| 16 | 0.0123 | 140 | 0.0002 |
| 17 | 0.0108 | 147 | 0.0001 |
| 18 | 0.0096 | 154 | 0.0001 |
| 19 | 0.0085 | 161 | 0.0001 |
| 20 | 0.0076 | 168 | 0.0001 |
| 21 | 0.0068 | 175 | 0.0001 |
| 22 | 0.0061 | 182 | 0.0001 |
| 23 | 0.0055 | 189 | 0.0000 |
| 24 | 0.0050 | 196 | 0.0000 |
| 25 | 0.0045 | 203 | 0.0000 |
| 26 | 0.0041 | 210 | 0.0000 |
| 27 | 0.0037 | 217 | 0.0000 |
| 28 | 0.0034 | 224 | 0.0000 |

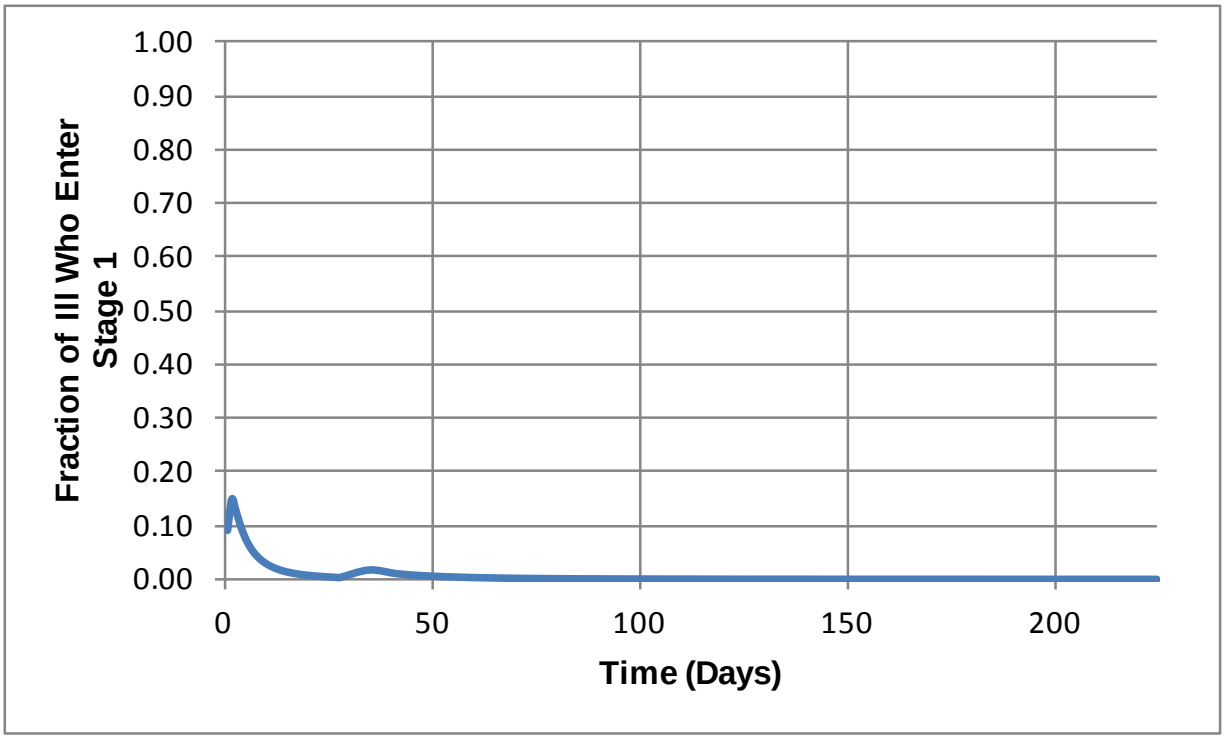


**Figure 24. Fraction of People Ill with Glanders Who Enter Stage 1 of Illness by Specified Day**

**Table 37. Fraction of Untreated People Ill with Glanders Who Enter Stage 2 of Illness on Specified Day**

| Day | Stage 2 | Day | Stage 2 |
|---|---|---|---|
| 1 | 0.0003 | 35 | 0.0358 |
| 2 | 0.0039 | 42 | 0.0183 |
| 3 | 0.0119 | 49 | 0.0104 |
| 4 | 0.0227 | 56 | 0.0064 |
| 5 | 0.0343 | 63 | 0.0042 |
| 6 | 0.0453 | 70 | 0.0028 |
| 7 | 0.0544 | 77 | 0.0020 |
| 8 | 0.0611 | 84 | 0.0014 |
| 9 | 0.0650 | 91 | 0.0011 |
| 10 | 0.0662 | 98 | 0.0008 |
| 11 | 0.0651 | 105 | 0.0006 |
| 12 | 0.0621 | 112 | 0.0005 |
| 13 | 0.0578 | 119 | 0.0004 |
| 14 | 0.0526 | 126 | 0.0003 |
| 15 | 0.0471 | 133 | 0.0002 |
| 16 | 0.0416 | 140 | 0.0002 |
| 17 | 0.0363 | 147 | 0.0002 |
| 18 | 0.0315 | 154 | 0.0001 |
| 19 | 0.0272 | 161 | 0.0001 |
| 20 | 0.0234 | 168 | 0.0001 |
| 21 | 0.0202 | 175 | 0.0001 |
| 22 | 0.0174 | 182 | 0.0001 |
| 23 | 0.0150 | 189 | 0.0001 |
| 24 | 0.0131 | 196 | 0.0000 |
| 25 | 0.0114 | 203 | 0.0000 |
| 26 | 0.0100 | 210 | 0.0000 |
| 27 | 0.0088 | 217 | 0.0000 |
| 28 | 0.0078 | 224 | 0.0000 |

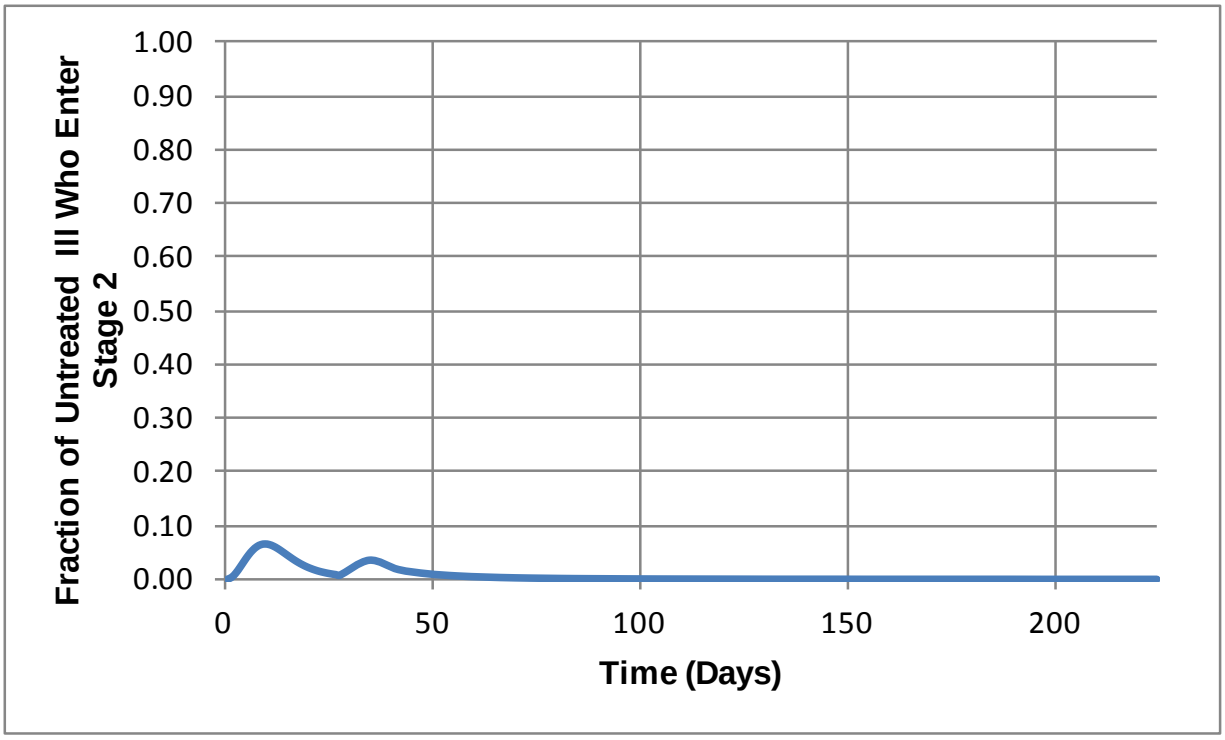


**Figure 25. Fraction of Untreated People Ill with Glanders Who Enter Stage 2 of Illness by Specified Day**

**Table 38. Fraction of Untreated People Ill with Glanders Who Enter Stage 3 of Illness on Specified Day**

| Day | Stage 3 | Day | Stage 3 |
|---|---|---|---|
| 1 | 0.0001 | 35 | 0.1525 |
| 2 | 0.0007 | 42 | 0.0884 |
| 3 | 0.0022 | 49 | 0.0459 |
| 4 | 0.0043 | 56 | 0.0230 |
| 5 | 0.0069 | 63 | 0.0120 |
| 6 | 0.0097 | 70 | 0.0068 |
| 7 | 0.0126 | 77 | 0.0042 |
| 8 | 0.0156 | 84 | 0.0028 |
| 9 | 0.0185 | 91 | 0.0019 |
| 10 | 0.0213 | 98 | 0.0014 |
| 11 | 0.0239 | 105 | 0.0010 |
| 12 | 0.0263 | 112 | 0.0007 |
| 13 | 0.0284 | 119 | 0.0006 |
| 14 | 0.0303 | 126 | 0.0004 |
| 15 | 0.0318 | 133 | 0.0003 |
| 16 | 0.0330 | 140 | 0.0003 |
| 17 | 0.0339 | 147 | 0.0002 |
| 18 | 0.0345 | 154 | 0.0002 |
| 19 | 0.0348 | 161 | 0.0001 |
| 20 | 0.0348 | 168 | 0.0001 |
| 21 | 0.0345 | 175 | 0.0001 |
| 22 | 0.0341 | 182 | 0.0001 |
| 23 | 0.0334 | 189 | 0.0001 |
| 24 | 0.0325 | 196 | 0.0001 |
| 25 | 0.0314 | 203 | 0.0001 |
| 26 | 0.0303 | 210 | 0.0000 |
| 27 | 0.0290 | 217 | 0.0000 |
| 28 | 0.0276 | 224 | 0.0000 |

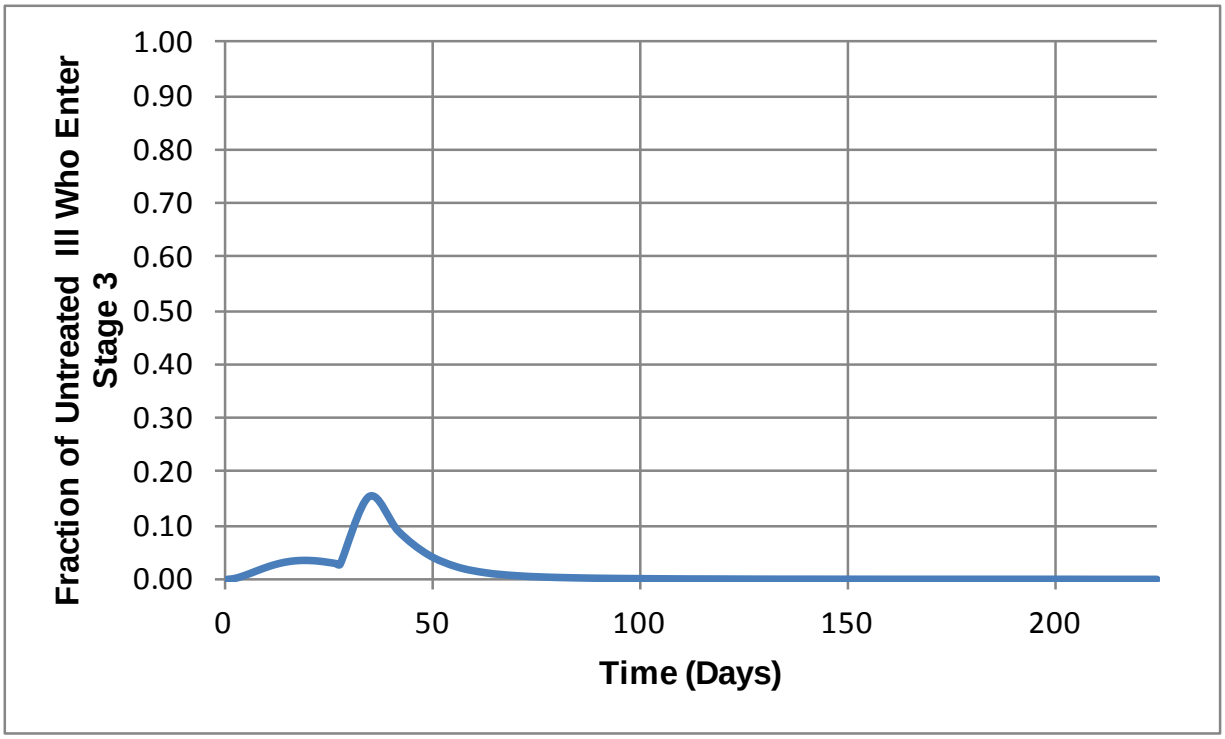


**Figure 26. Fraction of Untreated People Ill with Glanders Who Enter Stage 3 of Illness by Specified Day**

**Table 39. Fraction of Untreated Glanders Non-Survivors Who Die on Specified Day**

| Day | DOW | Day | DOW |
|---|---|---|---|
| 1 | 0.0000 | 35 | 0.1709 |
| 2 | 0.0004 | 42 | 0.1298 |
| 3 | 0.0013 | 49 | 0.0869 |
| 4 | 0.0025 | 56 | 0.0528 |
| 5 | 0.0040 | 63 | 0.0301 |
| 6 | 0.0057 | 70 | 0.0166 |
| 7 | 0.0075 | 77 | 0.0092 |
| 8 | 0.0094 | 84 | 0.0053 |
| 9 | 0.0112 | 91 | 0.0033 |
| 10 | 0.0131 | 98 | 0.0021 |
| 11 | 0.0149 | 105 | 0.0015 |
| 12 | 0.0166 | 112 | 0.0011 |
| 13 | 0.0183 | 119 | 0.0008 |
| 14 | 0.0198 | 126 | 0.0006 |
| 15 | 0.0212 | 133 | 0.0005 |
| 16 | 0.0225 | 140 | 0.0004 |
| 17 | 0.0237 | 147 | 0.0003 |
| 18 | 0.0247 | 154 | 0.0002 |
| 19 | 0.0255 | 161 | 0.0002 |
| 20 | 0.0262 | 168 | 0.0001 |
| 21 | 0.0268 | 175 | 0.0001 |
| 22 | 0.0272 | 182 | 0.0001 |
| 23 | 0.0274 | 189 | 0.0001 |
| 24 | 0.0276 | 196 | 0.0001 |
| 25 | 0.0276 | 203 | 0.0001 |
| 26 | 0.0274 | 210 | 0.0001 |
| 27 | 0.0272 | 217 | 0.0000 |
| 28 | 0.0268 | 224 | 0.0000 |

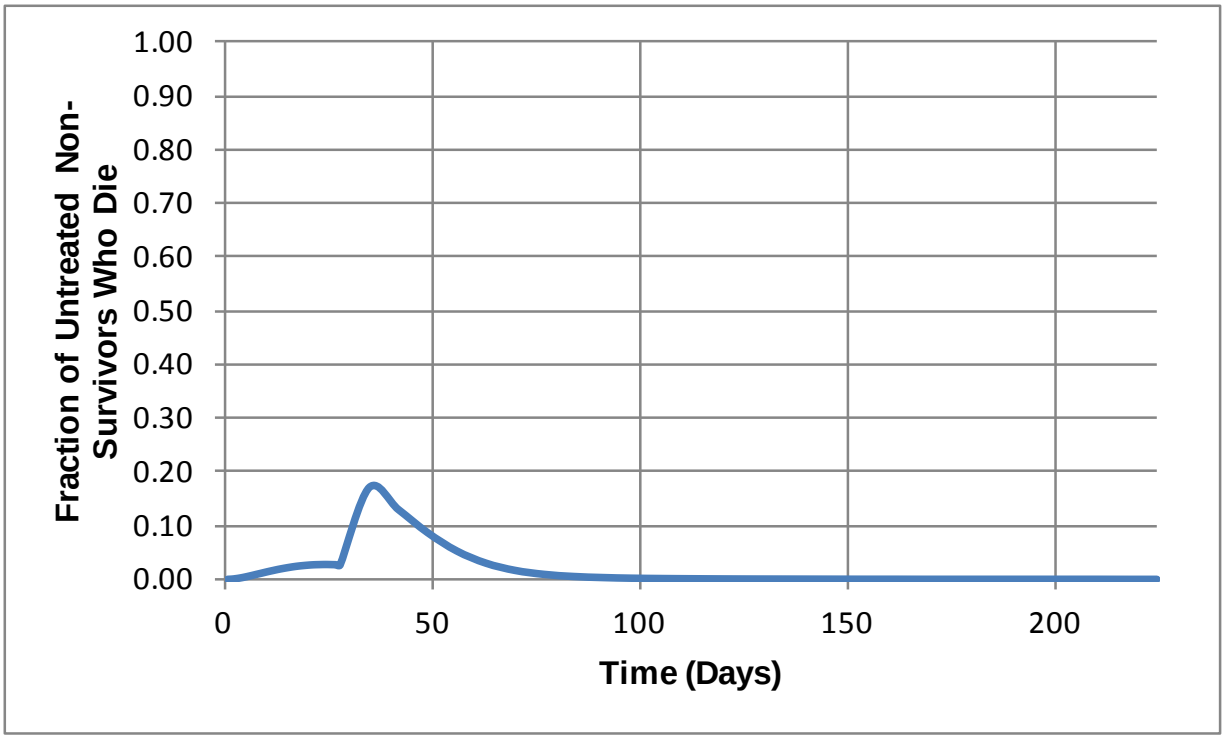


**Figure 27. Fraction of Untreated Glanders Non-Survivors Who Die by Specified Day**

**Table 40.Fraction of Treated People Ill with Glanders Who Enter Convalescence on Specified Day**

| Day | Convalescent | Day | Convalescent |
|---|---|---|---|
| 1 | 0.0000 | 35 | 0.1904 |
| 2 | 0.0000 | 42 | 0.0696 |
| 3 | 0.0000 | 49 | 0.0323 |
| 4 | 0.0000 | 56 | 0.0171 |
| 5 | 0.0000 | 63 | 0.0100 |
| 6 | 0.0000 | 70 | 0.0062 |
| 7 | 0.0000 | 77 | 0.0041 |
| 8 | 0.0000 | 84 | 0.0028 |
| 9 | 0.0000 | 91 | 0.0019 |
| 10 | 0.0000 | 98 | 0.0014 |
| 11 | 0.0000 | 105 | 0.0010 |
| 12 | 0.0000 | 112 | 0.0008 |
| 13 | 0.0000 | 119 | 0.0006 |
| 14 | 0.0000 | 126 | 0.0005 |
| 15 | 0.0000 | 133 | 0.0004 |
| 16 | 0.0000 | 140 | 0.0003 |
| 17 | 0.0000 | 147 | 0.0002 |
| 18 | 0.0000 | 154 | 0.0002 |
| 19 | 0.0000 | 161 | 0.0002 |
| 20 | 0.0000 | 168 | 0.0001 |
| 21 | 0.0000 | 175 | 0.0001 |
| 22 | 0.0897 | 182 | 0.0001 |
| 23 | 0.1467 | 189 | 0.0001 |
| 24 | 0.1258 | 196 | 0.0001 |
| 25 | 0.1006 | 203 | 0.0001 |
| 26 | 0.0801 | 210 | 0.0000 |
| 27 | 0.0643 | 217 | 0.0000 |
| 28 | 0.0522 | 224 | 0.0000 |

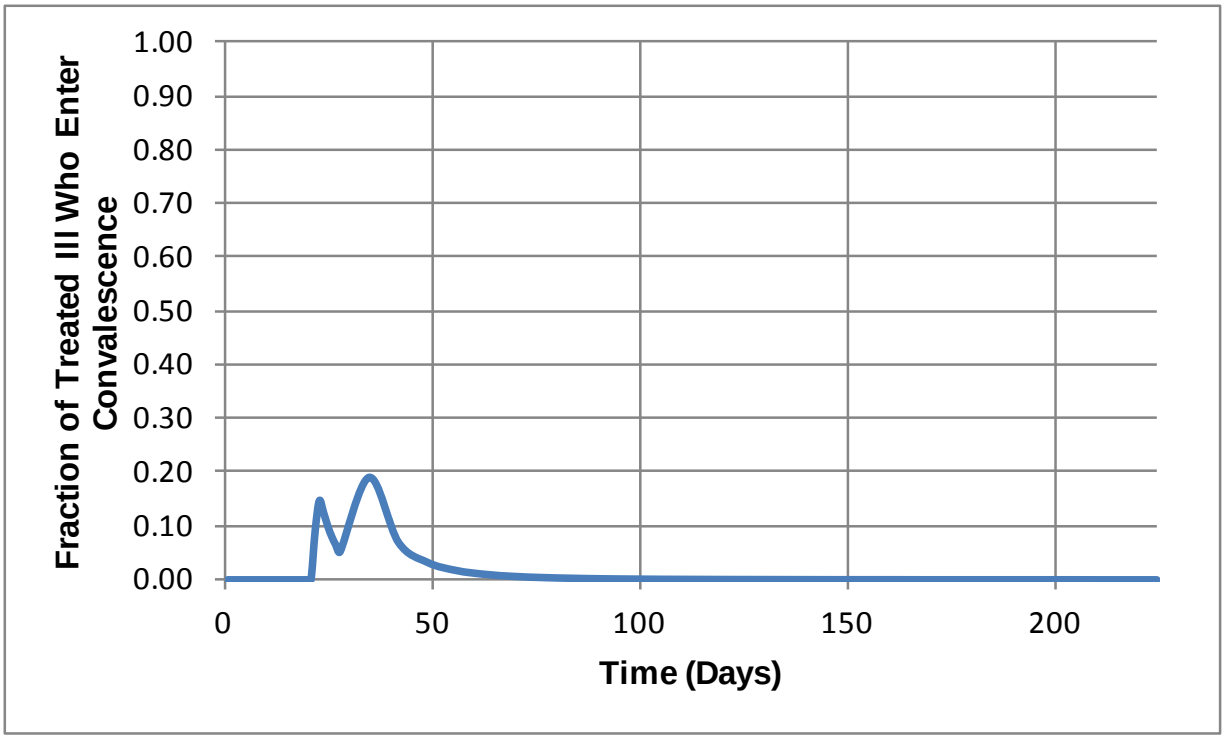


**Figure 28.Fraction of Treated People Ill with Glanders Who Enter Convalescence on Specified Day**

### f. A108.6 Q Fever Parameters and Lookup Tables

The following paragraphs describe the parameters and lookup tables needed to estimate casualties from Q fever, with and without consideration of medical care. They should be inserted after Section A108.5, Q Fever Parameters and Lookup Tables.

1. Infectivity. The probability of becoming ill with Q fever is modeled as a log-probit function with a probit slope of 0.782 probits/log(dose) and a median infectious dose ($ID_{50}$) of 30 organisms.[13] The infectious dose for Q fever can, therefore, be expressed as a random variable with a lognormal distribution whose CDF is:

$$p_{\text{E-Q-Fev}}(\mathrm{d}_n) = \frac{1}{2} + \frac{1}{2} erf\left[\frac{\ln(\mathrm{d}_n) - \mu}{\sigma\sqrt{2}}\right]$$

where:

*n* is the index number of the icon,

[13] Derived from data in W. D. Tigertt and A.S. Benenson, "Studies on Q Fever in Man," *Transactions of the Association of American Physicians* 69 (1956): 98–104. The unit of guinea pig injected $ID_{50}$ was converted to organisms using a factor of 1:2 reported in R. M. Ormsbee et al., "Limits of Rickettsial Infectivity," *Infection and Immunity* 19, no. 1 (January 1978): 239–45.

$P_{E\text{-}Q\text{-}Fev}$ ($d_n$) is the fraction of persons exposed to a dose d of *Coxiella burnetii*at Icon *n* who become ill (exposed and infected),

$d_n$ is the dose of *Coxiella burnetii* [organisms],

μ is the mean of the variable's natural logarithm [= ln($ID_{50}$ = ln(30organisms) = 3.40],

m is the probit slope [= 0.782probits/log(dose)],

σ is the standard deviation of the variable's natural logarithm [= $e^{1/m} = e^{1/0.782}$ = 3.59], and

*erf* is the error function where $erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2}\, dt.$

Figure 29 illustrates the probability of becoming ill from the dose of *Coxiella burnetii* inhaled.

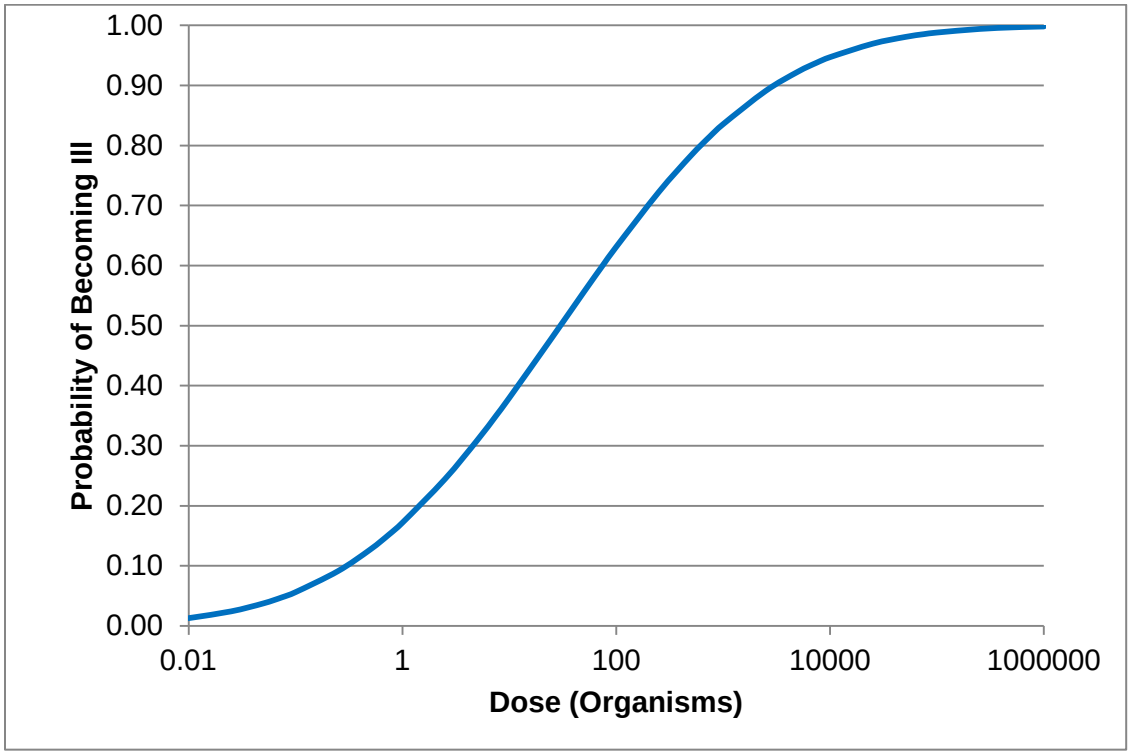


**Figure 29.Dose-Related Probability of Becoming Ill with Q Fever**

2. Lethality. Q fever is assumed to be 0% lethal.[14] Therefore $p_{f\text{-}Q\text{-}Fev}(d_n) = 0$ for all values of $d_n$, and there are no resulting DOW casualties.

3. Prophylaxis. Although vaccination against Q fever is not widely available, studies have shown the Q-Vax vaccine to be 100% efficacious in protecting individuals in occupational

[14] Assumption based on a 1–2% lethality rate and a statement of the underreporting of the disease reported in M. Maurin and D. Raoult, "Q Fever," *Clinical Microbiology Reviews* 12, no. 4 (October 1999): 518–53.

settings.[15] The Q fever model of prophylaxis, therefore, assumes all vaccinated individuals are fully protected against the onset of disease, and the efficacy of prophylaxis is 1.0.

**Table 41. Injury Profile for Q Fever**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 2 |

**Table 42. Day on Which People Ill with Q Fever Enter Stage 1 of Illness Given Dose**

| | Dose Range (Organisms) | |
|---|---|---|
| Day | > | ≤ |
| 20 | 0 | 2 |
| 19 | 2 | 7 |
| 18 | 7 | 24 |
| 17 | 24 | 82 |
| 16 | 82 | 279 |
| 15 | 279 | 952 |
| 14 | 952 | 3240 |
| 13 | 3240 | 11029 |
| 12 | 11029 | 37537 |
| 11 | 37537 | 127756 |
| 10 | 127756 | 434808 |
| 9 | 434808 | 1479833 |
| 8 | 1479833 | 5036486 |
| 7 | 5036486 | 17141252 |
| 6 | 17141252 | 58338793 |
| 5 | 58338793 | 198551119 |
| 4 | 198551119 | 675751835 |
| 3 | 675751835 | 2299863853 |
| 2 | 2299863853 | 7827390868 |
| 1 | 7827390868 | |

[15] David M. Waag, "Q Fever," in *Medical Aspects of Biological Warfare*, ed. Zygmunt F. Dembek, *Textbooks of Military* Medicine (Washington, DC: Department of Defense, Office of the Surgeon General, U.S. Army, Borden Institute, 2007).

**Table 43. Day on Which People Ill with Q Fever Return to Duty Given Dose**

| | Dose Range (Organisms) | |
|---|---|---|
| Day | > | ≤ |
| 25 | 0 | 2 |
| 24 | 2 | 7 |
| 23 | 7 | 24 |
| 22 | 24 | 82 |
| 21 | 82 | 279 |
| 20 | 279 | 952 |
| 19 | 952 | 3240 |
| 18 | 3240 | 11029 |
| 17 | 11029 | 37537 |
| 16 | 37537 | 127756 |
| 15 | 127756 | 434808 |
| 14 | 434808 | 1479833 |
| 13 | 1479833 | 5036486 |
| 12 | 5036486 | 17141252 |
| 11 | 17141252 | 58338793 |
| 10 | 58338793 | 198551119 |
| 9 | 198551119 | 675751835 |
| 8 | 675751835 | 2299863853 |
| 7 | 2299863853 | 7827390868 |
| 6 | 7827390868 | |

### g. A108.7 SEB Parameters and Lookup Tables

1. Effectivity. The probability of becoming ill with SEB intoxication is modeled as a log-probit function with a probit slope of 2.44 probits/log(dose)[16] and a median effective dose ($ED_{50}$) of 0.026 µg/man.[17] The effective dose of SEB can, therefore, be expressed as a random variable with a lognormal distribution whose CDF is:

$$p_{\text{E-SEB}}(\mathrm{d}_n) = \frac{1}{2} + \frac{1}{2} erf\left[\frac{\ln(\mathrm{d}_n) - \mu}{\sigma\sqrt{2}}\right]$$

16 Converted from a probit slope of 1.061 probits/ln dose reported in Anno et al., *AMedP-8 (Biological) Methods Report*, 94.

17 Anno et al., *AMedP-8 (Biological) Methods Report*, 94.

where:

*n* is the index number of the icon,

$p_{\text{E-SEB}}(d_n)$ is the fraction of persons exposed to a dose d of SEB at Icon *n* who become ill (exposed and infected),

$d_n$ is the dose of SEB [µg/man],

µ is the mean of the variable's natural logarithm [$= \ln(ED_{50} = \ln(0.026\ \mu g/man) = -3.65$],

m is the probit slope [= 2.44 probits/log(dose)],

σ is the standard deviation of the variable's natural logarithm [$= e^{1/m} = e^{1/2.44} = 1.51$], and

*erf* is the error function where $erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2}\, dt.$

Figure 30 illustrates the probability of becoming ill from the dose of SEB inhaled.

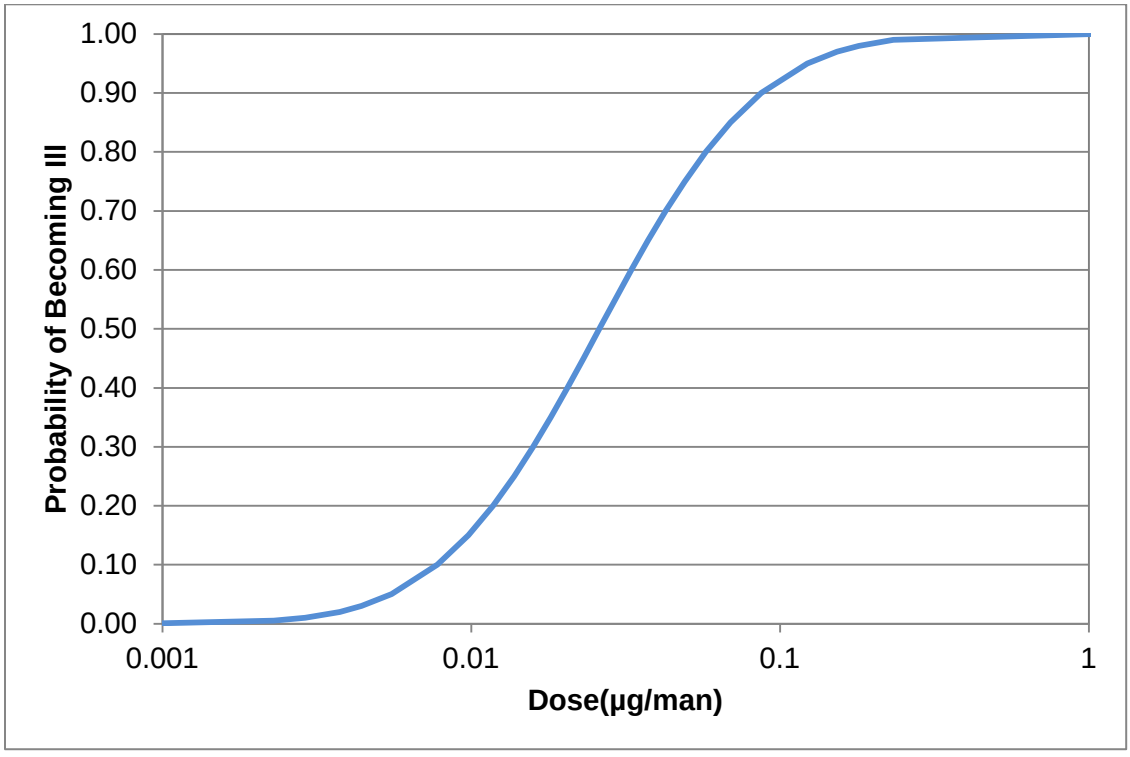


**Figure 30. Dose-Related Probability of Becoming Ill with SEB Intoxication**

2. Lethality. SEB lethality is modeled as a log-probit function with a probit slope of 2.44probits/log(dose)[18] and a median lethal dose ($LD_{50}$) of 1.4 μg/man.[19] The lethal dose of SEB can, therefore, be expressed as a random variable with a lognormal distribution whose CDF is:

$$p_{\text{f-SEB}}(\mathrm{d}_n) = \frac{1}{2} + \frac{1}{2} erf\left[\frac{\ln(\mathrm{d}_n) - \mu}{\sigma\sqrt{2}}\right]$$

where:

*n* is the index number of the icon,

$p_{\text{f-SEB}}(\mathrm{d}_n)$ is the fraction of persons exposed to a dose d of SEB at Icon *n* who die,

$\mathrm{d}_n$ is the dose of SEB [μg/man],

μ is the mean of the variable's natural logarithm [$= \ln(LD_{50} = \ln(1.4\ \mu g/man) = 0.336$],

m is the probit slope [= 2.44 probits/log(dose)],

σ is the standard deviation of the variable's natural logarithm [$= e^{1/m} = e^{1/2.44} = 1.51$], and

*erf* is the error function where $erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2}\, dt$.

Figure 31 illustrates the probability of dying from the dose of SEB inhaled.

[18] Assumed equal to the effectivity dose response probit slope.

[19] Assuming a 70 kg man, this value was calculated from the median lethal dose value reported in Janice M. Rusnak et al., "Laboratory Exposures to Staphylococcal Enterotoxin B," *Emerging Infectious Diseases* 10, 1548.

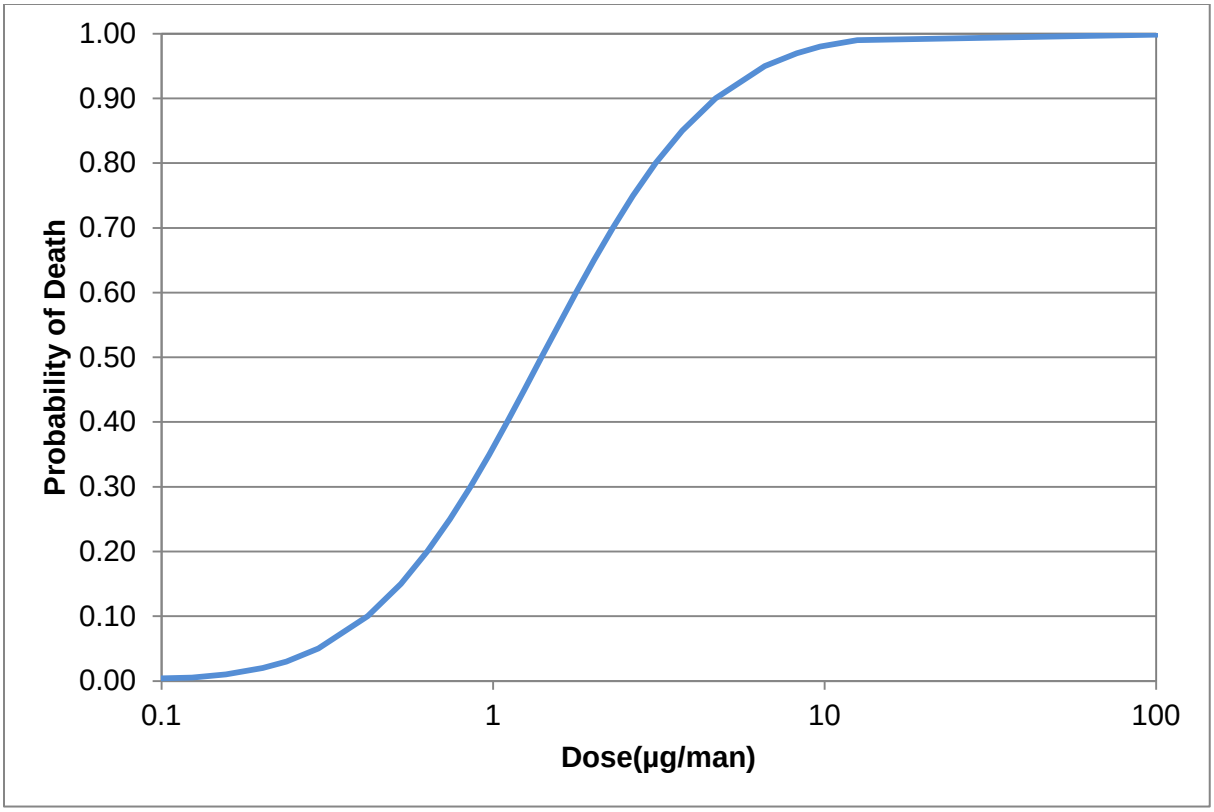


**Figure 31. Dose-Related Probability of Death from SEB Intoxication**

**Table 44. Injury Profile for SEB Survivors**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 3 |
| 2 | 1 |

**Table 45. Injury Profile for SEB Non-Survivors**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 3 |

**Table 46. Fraction of People Ill with SEB Intoxication Who Enter Stage 1 of Illness on Specified Day**

| Day | Stage 1 |
|---|---|
| 1 | 1 |
| >1 | 0 |

**Table 47. Day on Which SEB Non-Survivors Die Given Dose**

| | Dose Range (µg/man) | |
|---|---|---|
| **Day** | **>** | **≤** |
| 1 | 0 | 0.0239 |
| 2 | 0.0239 | 0.0885 |
| 3 | 0.0885 | 0.1532 |
| 4 | 0.1532 | 0.2178 |
| 5 | 0.2178 | 0.2824 |
| 6 | 0.2824 | 0.3470 |
| 7 | 0.3470 | 0.4116 |
| 8 | 0.4116 | 0.4762 |
| 9 | 0.4762 | |

**Table 48. Day on Which SEB Survivors Return to Duty Given Dose**

| | Dose Range (µg/man) | |
|---|---|---|
| **Day** | **>** | **≤** |
| 8 | 0 | 0.0239 |
| 9 | 0.0239 | 0.0885 |
| 10 | 0.0885 | 0.1532 |
| 11 | 0.1532 | 0.2178 |
| 12 | 0.2178 | 0.2824 |
| 13 | 0.2824 | 0.3470 |
| 14 | 0.3470 | 0.4116 |
| 15 | 0.4116 | 0.4762 |
| 16 | 0.4762 | |

### h. A108.8 Tularemia Parameters and Lookup Tables

1. Infectivity. The probability of becoming ill with tularemia is modeled as a log-probit function with a probit slope of 1.90 probits/log(dose) and a median infectious dose ($ID_{50}$) of 10 organisms.[20] The infectious dose of *Francisella tularensis* can, therefore, be expressed as a random variable with a lognormal distribution whose CDF is:

$$p_{\text{E-Tul}}(\mathrm{d}_n) = \frac{1}{2} + \frac{1}{2} erf\left[\frac{\ln(\mathrm{d}_n) - \mu}{\sigma\sqrt{2}}\right]$$

[20] Calculated from data provided in Saslaw et al., "Tularemia Vaccine Study, II: Respiratory Challenge," *Archives of Internal Medicine* 107 (1961): 134–146.

where:

*n* is the index number of the icon,

$p_{\text{E-Tul}}(d_n)$ is the fraction of persons exposed to a dose d of *Francisella tularensis* at Icon *n* who become ill (exposed and infected),

$d_n$ is the dose of *Francisella tularensis* [organisms],

μ is the mean of the variable's natural logarithm [$= \ln(ID_{50} = \ln(10 \text{ organisms}) = 2.30$],

m is the probit slope [= 1.90 probits/log(dose)],

σ is the standard deviation of the variable's natural logarithm [$= e^{1/m} = e^{1/1.90} = 1.69$], and

*erf* is the error function where $erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2}\, dt$.

Figure 32 illustrates the probability of becoming ill from the dose of *Francisella tularensis* inhaled.

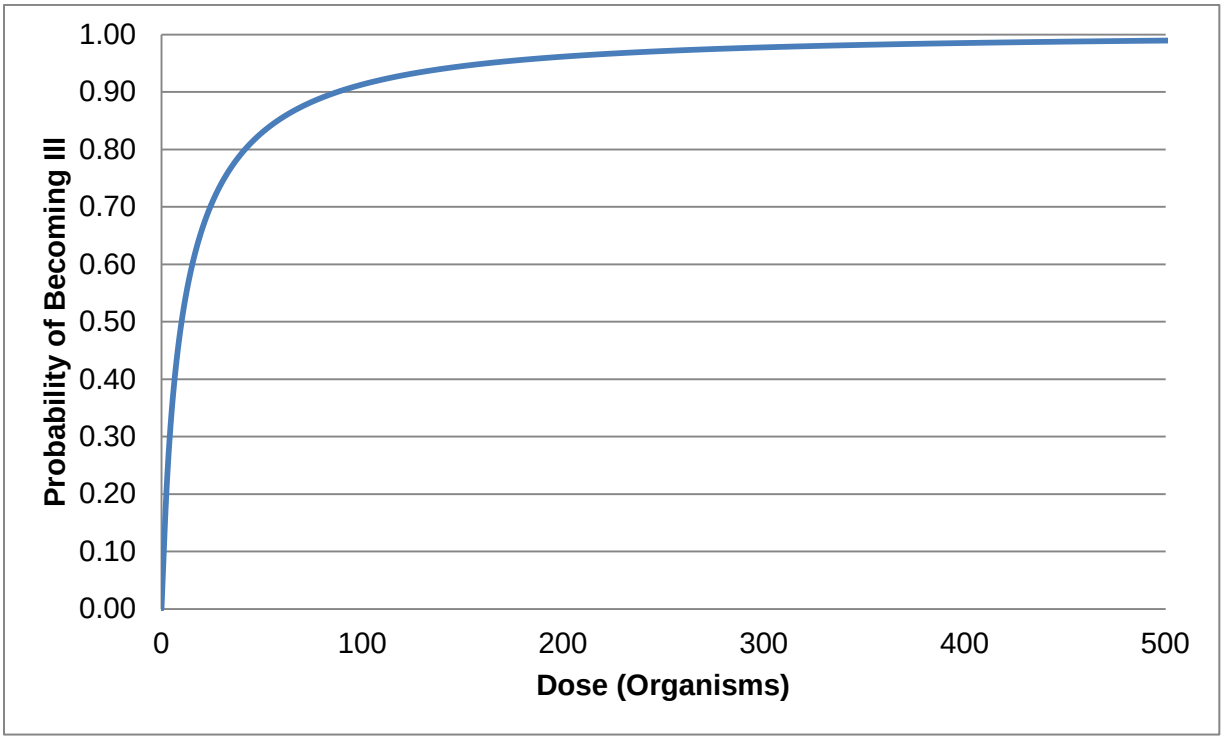


**Figure 32. Dose-Related Probability of Becoming Ill with Tularemia**

2. Lethality. The untreated case fatality rate for individuals ill with tularemia is approximately 75%.[21] A lethality rate of 75% will, therefore, be modeled for tularemia, so $p_{\text{f-Tul}}(d_n) = 0.75 * p_{\text{E-Tul}}(d_n)$.

**Table 49. Injury Profile for Untreated Tularemia Survivors**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 3 |
| 2 | 3 |
| 3 | 2 |

**Table 50. Injury Profile for Untreated Tularemia Non-Survivors**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 3 |
| 2 | 4 |

**Table 51. Injury Profile for Treated Tularemia Survivors**

| Stage | Sign/Symptom Severity Level |
|---|---|
| 1 | 3 |
| 2 | 2 |

**Table 52. Day on Which People Ill with Tularemia Enter Stage 1 of Illness Given Dose**

| | Dose Range (Organisms) | |
|---|---|---|
| Day | > | ≤ |
| 7 | 0 | 4 |
| 6 | 4 | 75 |
| 5 | 75 | 1241 |
| 4 | 1241 | 20502 |
| 3 | 20502 | 421696 |
| 2 | 421696 | |

[21] Based on the case fatality rate for typhoidal patients with pneumonia (six of eight) from Roscoe L. Pullen and Byron M. Stuart, "Tularemia: Analysis of 225 Cases," *Journal of the American Medical Association* 129, no. 7 (1945): 495–500.

**Table 53. Day on Which Untreated Tularemia Non-Survivors Die Given Dose**

| | Dose Range (Organisms) | |
|---|---|---|
| Day | > | ≤ |
| 22 | 0 | 4 |
| 21 | 4 | 75 |
| 20 | 75 | 1241 |
| 19 | 1241 | 20502 |
| 18 | 20502 | 421696 |
| 17 | 421696 | |

**Table 54. Day on Which Treated Tularemia Survivors Return to Duty Given Dose**

| | Dose Range (Organisms) | |
|---|---|---|
| Day | > | ≤ |
| 17 | 0 | 4 |
| 16 | 4 | 75 |
| 15 | 75 | 1241 |
| 14 | 1241 | 20502 |
| 13 | 20502 | 421696 |
| 12 | 421696 | |

# E. Contagious Biological Agent Parameters (Section A109)

## 1. Modifications

### a. A109.1 Plague Parameters

Paragraph A109.1.2 should be modified as follows:

2. Lethality. In the absence of treatment, pneumonic plague is assumed to be lethal in all cases,[22] and lethality is modeled for 100% of those individuals who become ill. In other words, without treatment, the probability of death ($p_f$) is equal to 1. If treatment is initiated within 24 hours of the onset of symptoms, all individuals who become ill are expected to survive, and the probability of death ($p_f$) is equal to 0. If treatment is delayed beyond 24 hours, it is assumed to be ineffective and the probability of death ($p_f$) is again considered equal to 1.[23]

[22] Gani and Leach, "Epidemiological Determinants"; Lathem et al., "Progression of Primary Pneumonic Plague"; and Kool, "Risk of Person-to-Person Transmission."

[23] Inglesby et al., "Plague as a Biological Weapon."

**b. A109.2 Smallpox Parameters**

Table A-51 should be modified as follows (two instances):

*Line out:* 2.8 days

(Stage 1 = Severity Level 2)

*Line in:* 3 days

(Stage 1 = Severity Level 2)

# 6. *AMedP-8(C)* Annex C Addenda

This chapter presents the addenda to *AMedP-8(C)* Annex C needed for consideration of medical care and the five additional biological agents.

## A. Nerve Agent Medical Care Parameters (Section C109)

This new section, C109, is added to describe the nerve agent medical care parameters provided as Table A-xx in Section A105.4. The sections that follow in Annex C should be renumbered accordingly.

### 1. Additions

The following text should be added as a new section C109, Nerve Agent Medical Care Parameters:

1. The parameters for modeling the impact of medical care on nerve agent casualties are derived from the GB and VX injury profiles and from human and animal studies described in the literature. Treatment is assumed to include decontamination, antidote therapy, and supportive care.

2. Impact on WIA. Medical care, including self- and buddy-aid, will not prevent an individual from becoming WIA at the time estimated by the GB and VX injury profiles. If the WIA severity criterion is WIA(1), use of nerve agent antidotes will alleviate many symptoms but mild ocular symptoms will persist; these symptoms will still dictate that an individual become a casualty in any dose range above the No Observable Effect level. If the WIA severity criterion is WIA(2) or WIA(3), symptoms cannot be alleviated through self- or buddy-aid alone and medical care will be required.

3. Impact on DOW. At the highest dose/dosage ranges shown in Tables A-15, A-16, and A-17, nerve agents are 100% lethal. The literature on human cases of nerve agent exposure with symptoms consistent with these dose ranges suggests that with treatment, many of these individuals would survive.[24] To model the increased survivability with treatment, a protection

[24] B.R. Clanton and J.R. Ward, *Case Report of a Severe Human Poisoning by GB* (Dugway Proving Ground, MD: Chemical Corps Medical Laboratories, 1952); David Grob, "The Manifestations and Treatment of Poisoning Due to Nerve Gas and Other Organic Phosphate Anticholinesterase Compounds," *Archives of Internal Medicine* 98, no. 2 (1956); Nozaki et al., "Secondary Exposure of Medical Staff"; Okumura et al., "Report on 640 Victims of the Tokyo Subway Sarin Attack." *Annals of Emergency Medicine* 28, no. 2 (1996): 129–35; Sidell, "Soman and Sarin"; Sidell, Newmark, and McDonough, "Nerve Agents."

factor is used to extend the upper limit of the existing non-lethal dose/dosage ranges. Animal studies with non-human primates suggest treatment is associated with a protection factor of 20 $LD_{50}$s;[25] this factor is used to derive new maximum non-lethal dose/dosage of 600 mg-min/$m^3$ for GB, 200 min-min/$m^3$ for inhaled VX, and 78 mg/man for percutaneous VX. Everyone within this modified dose band is estimated to survive but to require long-term convalescent care and will not return to duty. Dose/dosage levels greater than these maximum non-lethal levels are considered invariably lethal, even with medical care. In these cases, treatment will prolong but not preserve life; individuals are assumed to die after two weeks.[26]

4. Impact on RTD/Convalescence. The parameters for return to duty in Table A-xx are derived from human cases of nerve agent exposure documented in the literature.[27] Symptoms observed in those cases are matched to those associated with the dose/dosage bands in Table A-xx, and the time to resolution for those cases then used as the basis for return to duty. In this methodology, symptoms must abate to a level of severity less than that associated with the specified WIA criterion. Based on available data, in the first three dose/dosage bands, individuals will recover completely by the time they return to duty. In the dose/dosage band associated with 6.5–12 mg-min/$m^3$ for GB, 4–10 mg-min/$m^3$ for inhaled VX, and 1.6–3.9 mg/man for percutaneous VX, mild ocular symptoms are expected persist after other symptoms have resolved, resulting in a delay when WIA(1) is the casualty criterion and individuals must recover completely before returning to duty. As noted above, individuals in the highest non-lethal dose/dosage band do not return to duty but are assumed to remain convalescent indefinitely.

## B. HD Medical Care Parameters (Section C114)

This new section, C114, is added to describe the nerve agent medical care parameters provided as Table A-xx in Section A105.8. The sections that follow in Annex C should be renumbered accordingly.

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25 P. Dirnhuber et al., "Effectiveness of Pretreatment with Pyridostigmine in Protecting Rhesus Monkeys against Nerve Agent Poisoning," (Chemical Defense Establishment, 1977) and C.T. Olson et al., "Efficacies of Atropine/2-Pam and Atropine/Hi-6 in Treating Monkeys Intoxicated with Organophosphonate Nerve Agents," *International Journal of Toxicology* 16, no. 1 (1997).

26 The choice of two weeks is somewhat arbitrary, as there is limited human case data with wide variation in reported times to death. See Tetsu Okumura et al., "Report on 640 Victims of the Tokyo Subway Sarin Attack," *Annals of Emergency Medicine* 28, no. 2 (1996).

27 Okumura et al., "Report on 640 Victims"; David Grob and John C. Harvey, "Effects in Man of the Anticholinesterase Compound Sarin (Isopropyl Methyl Phosphonofluoridate)," *Journal of Clinical Investigation* 37, no. 3 (March 1958), Frederick R. Sidell and William A. Groff, "The Reactivatibility of Cholinesterase Inhibited by Vx and Sarin in Man," *Toxicology and Applied Pharmacology* 27 (1974).

## 1. Additions

The following text should be added as a new section C114, HD Medical Care Parameters:

1. The parameters for modeling the impact of medical care on HD casualties are derived from the HD injury profiles and descriptions of historical war casualties in the literature.[28] Treatment for HD casualties consists mainly of supportive care, which does little to accelerate the regeneration of damaged tissues and thus may not shorten recovery time.

2. Impact on WIA. Medical care will not prevent an individual from becoming WIA at the time estimated by the HD injury profiles.

3. Impact on DOW. DOWs are not expected at dosages less than 70 mg-min/$m^3$. For higher doses, the number and timing of DOWs provided in Table A-xx are derived from Willems' description of Iranian HD casualties treated in Europe[29] and from data on HD fatalities in World War 1.[30] Among these casualties, the fatality rate was 14%; this is the rate shown in Table A-xx. The distribution of time to death is based primarily on the World War I data set, as shown in Table C-xx below. In the Willems data set, the last fatality directly attributed to HD injury occurred on Day 16; this date was considered the last day on which DOWs would occur. The 62% of fatalities expected on Day 6 or later are assumed to be distributed evenly among Days 6 through 16.

**Table 55. Day of Death after Exposure in World War I Fatal Mustard Casualties**

| Day of Death (after exposure) | Percentage of Deaths |
|---|---|
| ≤1 | 1 |
| 2 | 2 |
| 3 | 5 |
| 4 | 8 |
| 5 | 22 |
| ≥6 | 62 |

4. Impact on RTD/Convalescence. For all dosage ranges of 70 mg-min/$m^3$ or less, the HD injury profiles describe all non-ocular symptoms as abating within a few days of injury, while untreated ocular symptoms may persist for several weeks. Hurst et al.[31] report that with treatment, the ocular symptoms associated with HD exposure will resolve within two weeks.

---

28 Cullumbine, "Mustard Gas"; Dana R. Anderson et al., "Sulfur Mustard-Induced Neutropenia: Treatment with Granulocyte Colony-Stimulating Factor," *Military Medicine* 171, no. 5 (2006); Jan L. Willems, Clinical Management of Mustard Gas Casualties," *Annales Mediciniae Militaris Belgicae* 3, no. suppl 1 (1989).

29 Willems, "Clinical Management," 4–5.

30 Charles G. Hurst et al., "Vesicants," in *Medical Aspects of Chemical Warfare*, ed. Shirley D. Tuorinsky, *Textbooks of Military Medicine* (Washington, DC: Department of Defense, Office of the Surgeon General, U.S. Army, Borden Institute, 2008), 263–65.

31 Hurst et al., "Vesicants," 266.

Thus for these dosage ranges, return to duty is assumed to occur at the time at which symptoms abate, as described by the HD injury profiles, or at two weeks, whichever is less. Above 70 mg-min/m$^3$ ocular symptoms become severe, and above 125 mg-min/m$^3$ skin lesions become more significant. Because the symptoms experienced by all individuals in the Willems data set are consistent with those postulated for dosage bands greater than 70 mg-min/m$^3$, the RTD and convalescent casualty distributions described in that data set have been used as the basis for the RTD and convalescent parameters provided in Table A-xx. Patients discharged within six weeks of injury are assumed to return to duty, while those discharged after six weeks are assumed to be convalescent.

## C. Whole Body Radiation Symptom Progression Maps, with Treatment (Section C117)

### 1. Additions

The following figures and tables should be inserted as a new section, C117, Whole Body Radiation Symptom Progression Maps, with Treatment, to describe the changes to whole body radiation symptom progression maps and dose ranges with supportive care and radiation antiemetics. Subsequent sections should be renumbered accordingly.

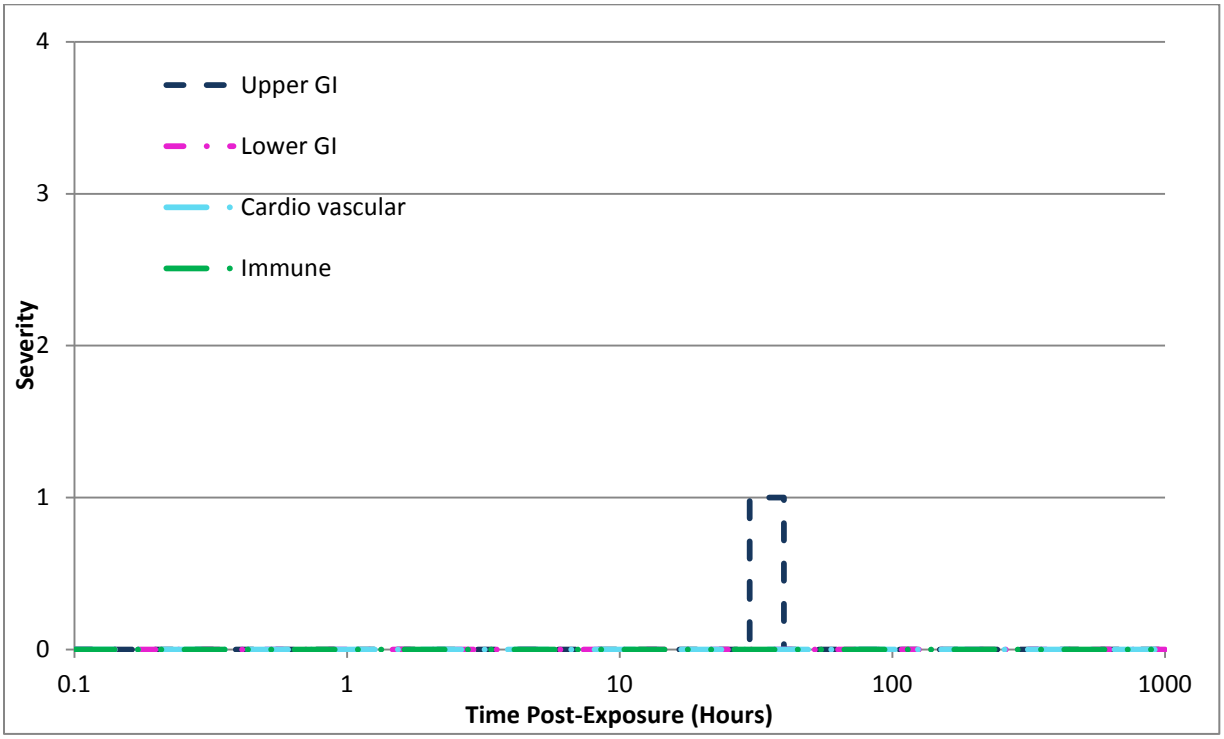


**Figure 33. Physiological Symptom Progressions for Whole-Body Radiation Dose Range 3–< 5.3 Gy, with Treatment**

**Table 56. Symptom Severity by Physiological System for Whole-Body Radiation Dose Range 3–< 5.3 Gy, with Treatment**

| Time Point (hr) | Upper GI | Lower GI | Cardiovascular | Immune |
|---|---|---|---|---|
| 0.1 | 0 | 0 | 0 | 0 |
| 0.2 | 0 | 0 | 0 | 0 |
| 0.3 | 0 | 0 | 0 | 0 |
| 0.4 | 0 | 0 | 0 | 0 |
| 0.5 | 0 | 0 | 0 | 0 |
| 0.6 | 0 | 0 | 0 | 0 |
| 0.7 | 0 | 0 | 0 | 0 |
| 0.8 | 0 | 0 | 0 | 0 |
| 0.9 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 |
| 7 | 0 | 0 | 0 | 0 |
| 8 | 0 | 0 | 0 | 0 |
| 9 | 0 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 | 0 |
| 30 | 1 | 0 | 0 | 0 |
| 40 | 1 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 |
| 90 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 |
| 200 | 0 | 0 | 0 | 0 |
| 300 | 0 | 0 | 0 | 0 |
| 336 | 0 | 0 | 0 | 0 |
| 400 | 0 | 0 | 0 | 0 |
| 500 | 0 | 0 | 0 | 0 |
| 600 | 0 | 0 | 0 | 0 |
| 700 | 0 | 0 | 0 | 0 |
| 800 | 0 | 0 | 0 | 0 |
| 900 | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 | 0 | 0 |

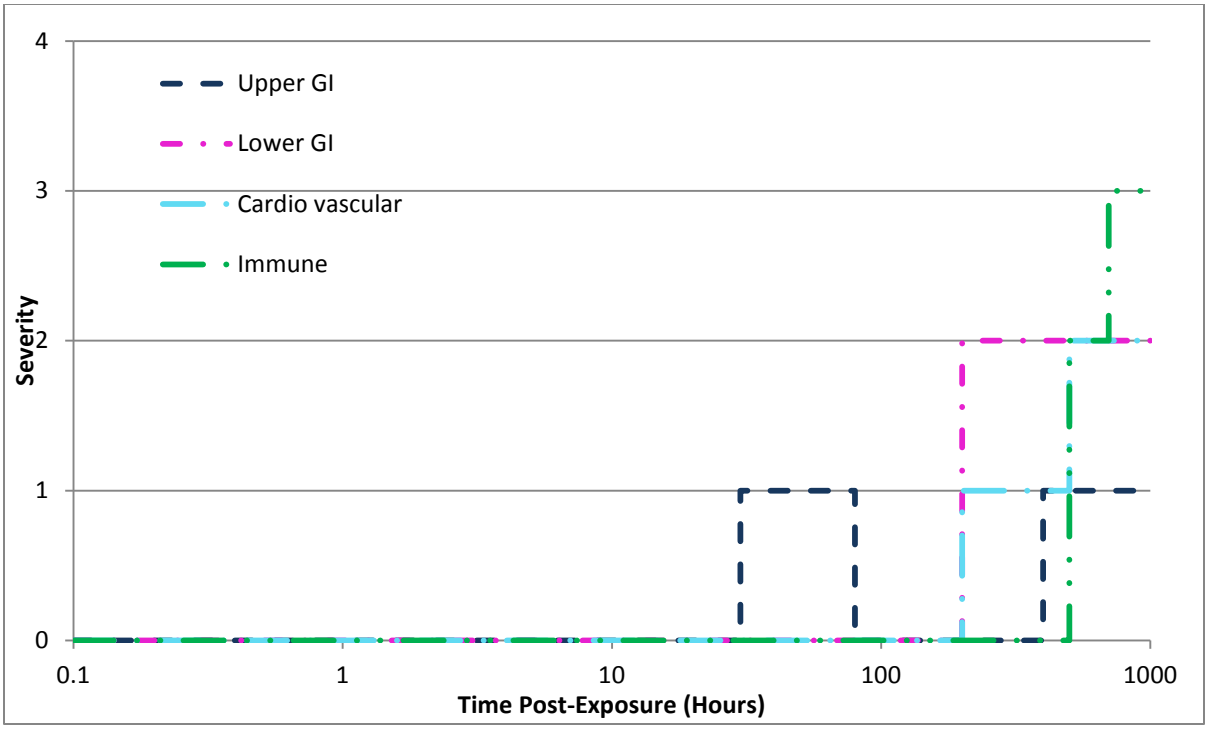


**Figure 34. Physiological Symptom Progressions for Whole-Body Radiation Dose Range 5.3–<7 Gy, with Treatment**

**Table 57. Symptom Severity by Physiological System for Whole-Body Radiation Dose Range 5.3–< 7 Gy, with Treatment**

| Time Point (hr) | Upper GI | Lower GI | Cardio vascular | Immune |
|---|---|---|---|---|
| 0.1 | 0 | 0 | 0 | 0 |
| 0.2 | 0 | 0 | 0 | 0 |
| 0.3 | 0 | 0 | 0 | 0 |
| 0.4 | 0 | 0 | 0 | 0 |
| 0.5 | 0 | 0 | 0 | 0 |
| 0.6 | 0 | 0 | 0 | 0 |
| 0.7 | 0 | 0 | 0 | 0 |
| 0.8 | 0 | 0 | 0 | 0 |
| 0.9 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 |
| 7 | 0 | 0 | 0 | 0 |
| 8 | 0 | 0 | 0 | 0 |
| 9 | 0 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 0 |
| 30 | 1 | 0 | 0 | 0 |
| 40 | 1 | 0 | 0 | 0 |
| 50 | 1 | 0 | 0 | 0 |
| 60 | 1 | 0 | 0 | 0 |
| 70 | 1 | 0 | 0 | 0 |
| 80 | 1 | 0 | 0 | 0 |
| 90 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 |
| 200 | 0 | 0 | 0 | 0 |
| 200 | 0 | 2 | 1 | 0 |
| 300 | 0 | 2 | 1 | 0 |
| 336 | 0 | 2 | 1 | 0 |
| 400 | 1 | 2 | 1 | 0 |
| 500 | 1 | 2 | 2 | 2 |
| 600 | 1 | 2 | 2 | 2 |
| 700 | 1 | 2 | 2 | 3 |
| 800 | 1 | 2 | 2 | 3 |
| 900 | 1 | 2 | 2 | 3 |
| 1000 | 1 | 2 | 2 | 3 |

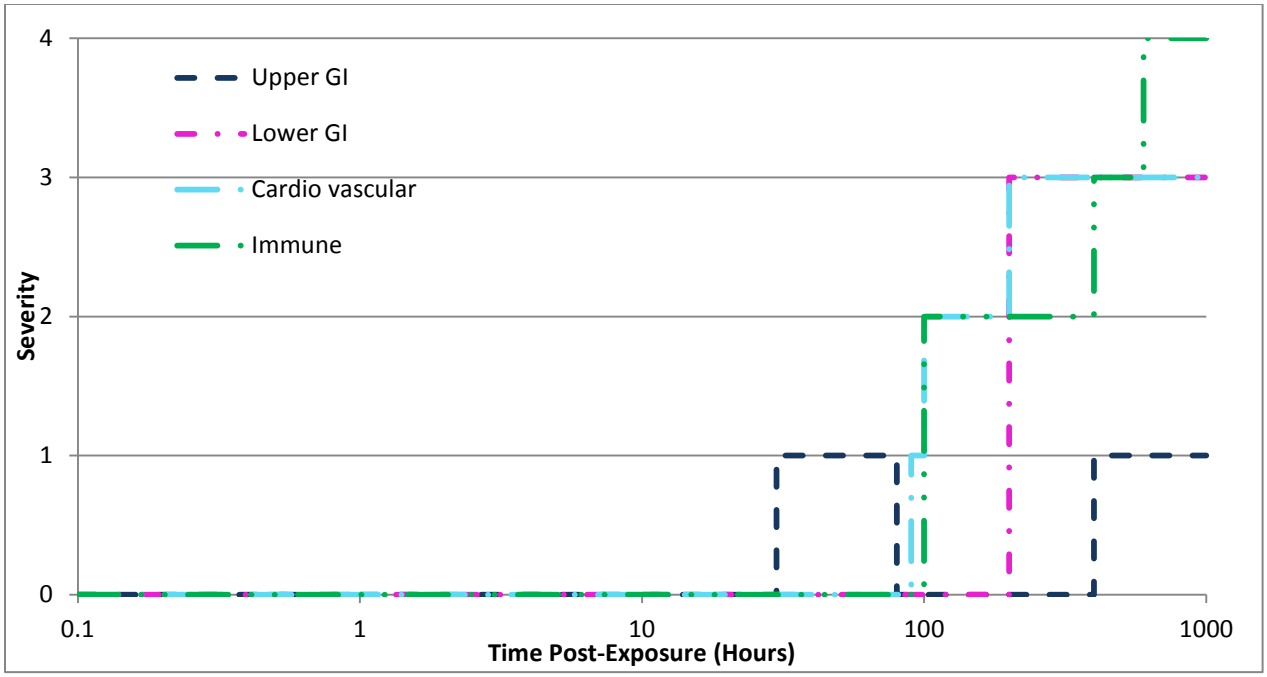


**Figure 35. Physiological Symptom Progressions for Whole-Body Radiation Dose Range 7–<8.3 Gy, with Treatment**

**Table 58. Symptom Severity by Physiological System for Whole-Body Radiation Dose Range 7–< 8.3 Gy, with Treatment**

| Time Point (hr) | Upper GI | Lower GI | Cardio vascular | Immune |
|---|---|---|---|---|
| 0.1 | 0 | 0 | 0 | 0 |
| 0.2 | 0 | 0 | 0 | 0 |
| 0.3 | 0 | 0 | 0 | 0 |
| 0.4 | 0 | 0 | 0 | 0 |
| 0.5 | 0 | 0 | 0 | 0 |
| 0.6 | 0 | 0 | 0 | 0 |
| 0.7 | 0 | 0 | 0 | 0 |
| 0.8 | 0 | 0 | 0 | 0 |
| 0.9 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 |
| 7 | 0 | 0 | 0 | 0 |
| 8 | 0 | 0 | 0 | 0 |
| 9 | 0 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 0 |
| 30 | 1 | 0 | 0 | 0 |
| 40 | 1 | 0 | 0 | 0 |
| 50 | 1 | 0 | 0 | 0 |
| 60 | 1 | 0 | 0 | 0 |
| 70 | 1 | 0 | 0 | 0 |
| 80 | 1 | 0 | 0 | 0 |
| 90 | 0 | 0 | 1 | 0 |
| 100 | 0 | 0 | 2 | 2 |
| 200 | 0 | 3 | 3 | 2 |
| 300 | 0 | 3 | 3 | 2 |
| 336 | 0 | 3 | 3 | 2 |
| 400 | 0 | 3 | 3 | 2 |
| 400 | 1 | 3 | 3 | 3 |
| 500 | 1 | 3 | 3 | 3 |
| 600 | 1 | 3 | 3 | 4 |
| 700 | 1 | 3 | 3 | 4 |
| 800 | 1 | 3 | 3 | 4 |
| 900 | 1 | 3 | 3 | 4 |
| 1000 | 1 | 3 | 3 | 4 |

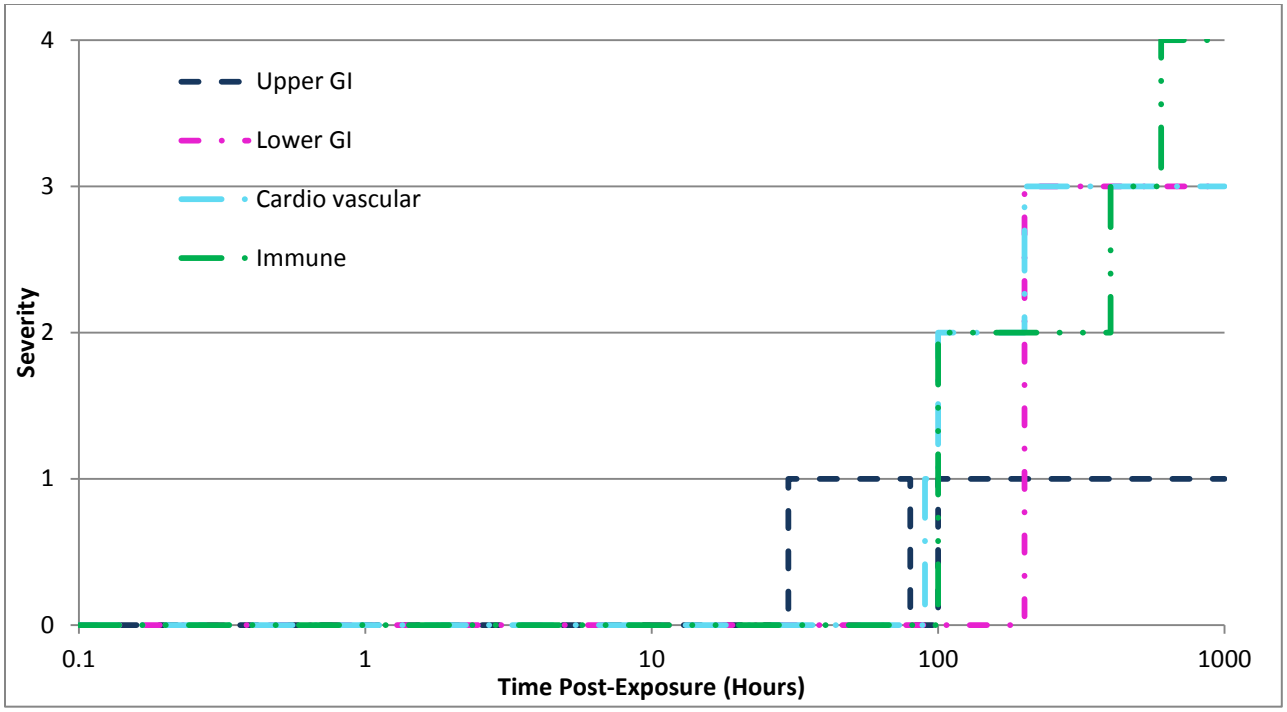


**Figure 36. Physiological Symptom Progressions for Whole-Body Radiation Dose Range 8.3–<10 Gy, with Treatment**

**Table 59. Symptom Severity by Physiological System for Whole-Body Radiation Dose Range 8.3–< 10 Gy, with Treatment**

| Time Point (hr) | Upper GI | Lower GI | Cardio vascular | Immune |
|---|---|---|---|---|
| 0.1 | 0 | 0 | 0 | 0 |
| 0.2 | 0 | 0 | 0 | 0 |
| 0.3 | 0 | 0 | 0 | 0 |
| 0.4 | 0 | 0 | 0 | 0 |
| 0.5 | 0 | 0 | 0 | 0 |
| 0.6 | 0 | 0 | 0 | 0 |
| 0.7 | 0 | 0 | 0 | 0 |
| 0.8 | 0 | 0 | 0 | 0 |
| 0.9 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 |
| 7 | 0 | 0 | 0 | 0 |
| 8 | 0 | 0 | 0 | 0 |
| 9 | 0 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 0 |
| 30 | 1 | 0 | 0 | 0 |
| 40 | 1 | 0 | 0 | 0 |
| 50 | 1 | 0 | 0 | 0 |
| 60 | 1 | 0 | 0 | 0 |
| 70 | 1 | 0 | 0 | 0 |
| 80 | 1 | 0 | 0 | 0 |
| 90 | 0 | 0 | 1 | 0 |
| 100 | 1 | 0 | 2 | 2 |
| 200 | 1 | 3 | 3 | 2 |
| 300 | 1 | 3 | 3 | 2 |
| 336 | 1 | 3 | 3 | 2 |
| 400 | 1 | 3 | 3 | 3 |
| 500 | 1 | 3 | 3 | 3 |
| 600 | 1 | 3 | 3 | 4 |
| 700 | 1 | 3 | 3 | 4 |
| 800 | 1 | 3 | 3 | 4 |
| 900 | 1 | 3 | 3 | 4 |
| 1000 | 1 | 3 | 3 | 4 |

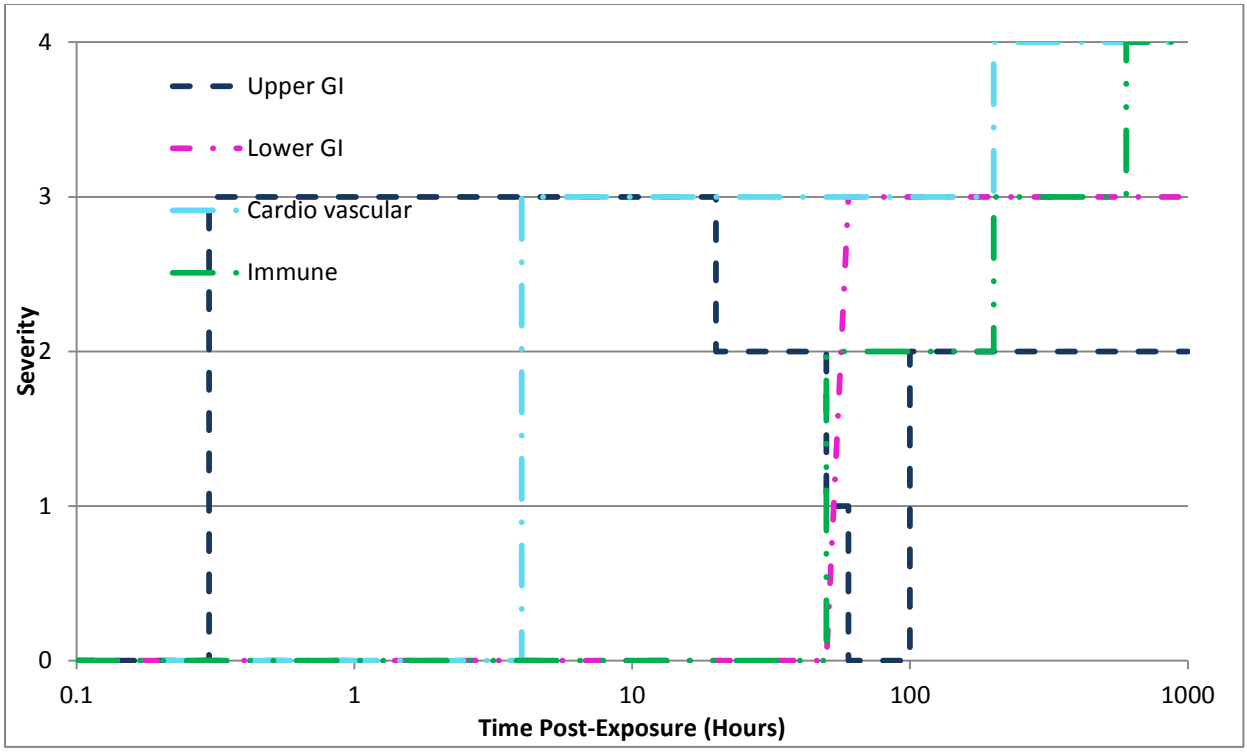


**Figure 37. Physiological Symptom Progressions for Whole-Body Radiation Dose Range ≥10 Gy, with Treatment**

**Table 60. Symptom Severity by Physiological System for Whole-Body Radiation Dose Range ≥ 10 Gy, with Treatment**

| Time Point (hr) | Upper GI | Lower GI | Cardio vascular | Immune |
|---|---|---|---|---|
| 0.1 | 0 | 0 | 0 | 0 |
| 0.2 | 0 | 0 | 0 | 0 |
| 0.3 | 0 | 0 | 0 | 0 |
| 0.3 | 3 | 0 | 0 | 0 |
| 0.4 | 3 | 0 | 0 | 0 |
| 0.5 | 3 | 0 | 0 | 0 |
| 0.6 | 3 | 0 | 0 | 0 |
| 0.7 | 3 | 0 | 0 | 0 |
| 0.8 | 3 | 0 | 0 | 0 |
| 0.9 | 3 | 0 | 0 | 0 |
| 1 | 3 | 0 | 0 | 0 |
| 2 | 3 | 0 | 0 | 0 |
| 3 | 3 | 0 | 0 | 0 |
| 4 | 3 | 0 | 3 | 0 |
| 5 | 3 | 0 | 3 | 0 |
| 6 | 3 | 0 | 3 | 0 |
| 7 | 3 | 0 | 3 | 0 |
| 8 | 3 | 0 | 3 | 0 |
| 9 | 3 | 0 | 3 | 0 |
| 10 | 3 | 0 | 3 | 0 |
| 20 | 2 | 0 | 3 | 0 |
| 30 | 2 | 0 | 3 | 0 |
| 40 | 2 | 0 | 3 | 0 |
| 50 | 1 | 0 | 3 | 2 |
| 60 | 1 | 3 | 3 | 2 |
| 70 | 0 | 3 | 3 | 2 |
| 80 | 0 | 3 | 3 | 2 |
| 90 | 0 | 3 | 3 | 2 |
| 100 | 2 | 3 | 3 | 2 |
| 200 | 2 | 3 | 4 | 3 |
| 300 | 2 | 3 | 4 | 3 |
| 336 | 2 | 3 | 4 | 3 |
| 400 | 2 | 3 | 4 | 3 |
| 500 | 2 | 3 | 4 | 3 |
| 600 | 2 | 3 | 4 | 4 |
| 700 | 2 | 3 | 4 | 4 |
| 800 | 2 | 3 | 4 | 4 |
| 900 | 2 | 3 | 4 | 4 |
| 1000 | 2 | 3 | 4 | 4 |

# D. Anthrax Model Parameters (Section C126)

## 1. Modifications

Table C-46 should be replaced with the following table:

**Table 61. Anthrax Model Parameters Summary Table**

| Submodel | Type | Parameters |
|---|---|---|
| Infectivity | Exponential distribution | $\lambda = 1.36 \times 10^{-5}$ |
| Incubation Period | Parametric lognormal distribution | $M = \alpha + \beta \log(d_n)$<br>$\alpha = 10.3$<br>$\beta = -1.35$<br>$\sigma = \gamma + \delta \log(d_n)$<br>$\gamma = 0.804$<br>$\delta = -0.079$<br>$d_n$ = dose |
| Lethality | | |
| Untreated | Rate | 100% |
| Treatment Initiated in Stage 1 | Linear function | a = 0.1, b = 0.012 |
| Treatment Initiated in Stage 2 | Rate | 100% |
| Duration of Illness, Untreated | | |
| Stage 1 | Lognormal distribution | Mean = 4.2 days<br>Standard deviation = 2.3 days |
| Stage 2 | Lognormal distribution | Mean = 0.70 days<br>Standard deviation = 0.74 days |
| Duration of Illness, Treatment Initiated in Stage 1 | | |
| Stage 1 (All) | Lognormal distribution | Mean = 5.8 days<br>Standard deviation = 2.0 days |
| Stage 2 (All) | Lognormal distribution | Mean = 1.4 days<br>Standard deviation = 1.8 days |
| Stage 3 (Survivors) | Constant | 11 days |
| Stage 4 (Survivors) | Constant | 60 days |
| Duration of Illness, Treatment Initiated in Stage 2 | | |
| Stage 1 | Lognormal distribution | Mean = 4.2 days<br>Standard deviation = 2.3 days |
| Stage 2 | Lognormal distribution | Mean = 1.5 days<br>Standard deviation = 1.3 days |

Paragraph C126.1should be modified to read:

1. Infectivity. The infective dose of anthrax is modeled as a random variable with an exponential distribution with parameter $\lambda = 1.36x10^{-5}$, which corresponds to a median lethal dose ($LD_{50}$) of approximately 51,000 spores (mean of ~73,500 spores) (see Section A108.1).

Paragraph C126.3 should be modified to read:

3. Lethality. For untreated individuals and individuals first administered antibiotics during Stage 2 of illness, lethality is modeled as a rate of 100%, if symptomatic ($p_{f\text{-}Anth}(d_n) = p_{E\text{-}Anth}(d_n)$). If antibiotic treatment is initiated t days after symptom onset during Stage 1, then $p_{f\text{-}Anth}(d_n) = (0.1 + 0.012*t)*p_{E\text{-}Anth}(d_n)$.

Paragraph C126.4 should be modified to read:

4. Injury profile. Without treatment, anthrax has only one injury profile—for non-survivors—associated with it. The profile characterizes the symptomatic period of illness and divides this period into two distinct stages.[32] The signs and symptoms characterizing each stage as well as the corresponding sign/symptom severity level for each stage are described in Table C-47.[33] Since treatment can prevent some deaths from anthrax, there are both non-survivor and survivor treated injury profiles, shown in Table C-xx and Table C-xx. Treated non-survivors are still modeled to die after two stages, while survivors are modeled to recover following four stages of illness. The durations of each injury profile's stages are determined by the "duration of illness" models discussed in the following section.

Table C-47 should be replaced with the following table:

[32] Depending on the dose and physiological manifestation of the disease, there may be a brief mitigation or even cessation of symptoms between these two stages (hours) that is not captured by the injury profile.

[33] Brachman, "Inhalation Anthrax"; Holty et al., "Systematic Review"; T. V. Inglesby et al., "Anthrax as a Biological Weapon, 2002," *Journal of the American Medical Association* 287, no. 17 (May 2002): 2236–52; and J. A. Jernigan et al., "Bioterrorism-Related Inhalational Anthrax: The First 10 Cases Reported in the United States," *Emerging Infectious Diseases* 7, no. 6 (November-December 2001): 933–44.

**Table 62. Untreated Anthrax Non-Survivor Injury Profile**

| | Stage 1 | Stage 2 |
|---|---|---|
| Signs and Symptoms (S/S) | Flu-like symptoms including malaise, fatigue, drenching sweats, fever, headache, and chills; nausea and vomiting; nonproductive cough; mild chest discomfort and dyspnea; myalgia. | Persistent fever; sudden onset of increasing respiratory distress (increased chest pain, dyspnea, stridor, cyanosis and diaphoresis) leading to respiratory failure and eventual death; tachycardia, tachypnea, hypotension, leading to cardiovascular collapse and death; altered neurological status (confusion, syncope, or coma) meningioencephalitis likely; edema of chest and neck may be present; pleural effusion and likely widening and edemas of the mediastinum. |
| S/S Severity | 2 (Moderate) | 4 (Very Severe) |
| Outlook | Individual will progress to Stage 2. | Individual will die. |

Paragraph C126.5 should be modified to read:

a. Untreated non-survivors. The duration of Stage 1 for untreated non-survivors is modeled as a lognormally distributed random variable with a mean value of 4.2 days and standard deviation of 2.3 days,[34] such that the cumulative fraction of untreated persons who complete Stage 1 is:

$$F_{\text{Stg1-Anth}_{\text{N,U}}}(t_{\text{Stg1}}) = \frac{1}{2} + \frac{1}{2}\left( erf\left( \frac{\ln(t_{\text{Stg1}}) - \mu_{\text{Stg1}}}{\sigma_{\text{Stg1}}\sqrt{2}} \right) \right)$$

where:

$F_{\text{Stg1-Anth}_{\text{N,U}}}$ is the cumulative fraction of persons ill with anthrax who have completed Stage 1 without treatment and entered Stage 2…

Paragraph C126.6 should be modified to read:

6. Prophylaxis. Pre-exposure vaccination, post-exposure antibiotics, pre-exposure vaccination combined with post-exposure antibiotics, or post-exposure vaccination and antibiotics are modeled as prophylaxis against anthrax (see Section A108.1). The efficacy of the prophylaxis is 0.90 for pre-exposure vaccination or post-exposure antibiotics alone and 1.0 for antibiotics combined with vaccination. For the 10% for which post-exposure antibiotics are ineffective, the untreated illness begins at the end of the antibiotic regimen, or 60 days after the start of antibiotic prophylaxis.

[34] Holty et al., "Systematic Review"; and Jon-Erik C. Holty, e-mail correspondence, 12–13 May 2009.

## 2. Additions

The following tables should be added to Section C127, following Table C-47, Untreated Anthrax Non-Survivor Injury Profile.

**Table 63. Treated Anthrax Non-Survivor Injury Profile**

| | Stage 1 | Stage 2 |
|---|---|---|
| Signs and Symptoms (S/S) | Flu-like symptoms including malaise, fatigue, drenching sweats, fever, headache, and chills; nausea and vomiting; nonproductive cough; mild chest discomfort and dyspnea; myalgia. | Fever; sudden onset of increasing respiratory distress; tachycardia, tachypnea, hypotension; altered neurological status (confusion, syncope, or coma) meningioencephalitis; pleural effusion and likely widening and edemas of the mediastinum. |
| S/S Severity | 3 (Severe) | 4 (Very Severe) |
| Outlook | Individual will progress to Stage 2. | Individual will die. |

**Table 64. Treated Anthrax Survivor Injury Profile**

| | Stage 1 | Stage 2 | Stage 3 | Stage 4 |
|---|---|---|---|---|
| Signs and Symptoms (S/S) | Flu-like symptoms including malaise, fatigue, drenching sweats, fever, headache, and chills; nausea and vomiting; nonproductive cough; mild chest discomfort and dyspnea; myalgia. | Fever; sudden onset of increasing respiratory distress; tachycardia, tachypnea, hypotension; altered neurological status (confusion, syncope, or coma) meningioencephalitis; pleural effusion and likely widening and edemas of the mediastinum. | Resolution of fever, gradual cessation of acute symptoms. | Malaise, weakness. |
| S/S Severity | 3 (Severe) | 4 (Very Severe) | 3 (Severe) | 2 (Moderate) |
| Outlook | Individual will progress to Stage 2. | Individual will progress to Stage 3. | Individual will progress to Stage 4. | Individual will return to duty. |

The following duration of illness parameters for treated anthrax survivors and non-survivors should be added after paragraph C126.5.b:

c. Treated survivors. The duration of Stage 1 for survivors initially treated in the prodromal phase (Stage 1) is modeled as a lognormally distributed random variable with a

mean value of 5.8 days and standard deviation of 2.0 days,[35] such that the cumulative fraction of treated persons who complete Stage 1 is:

$$F_{\text{Stg1}-\text{Anth}_{S,T}}(t_{\text{Stg1}}) = \frac{1}{2} + \frac{1}{2}\left( erf\left(\frac{\ln(t_{\text{Stg1}}) - \mu_{\text{Stg1}}}{\sigma_{\text{Stg1}}\sqrt{2}}\right)\right)$$

where:

$F_{\text{Stg1-Anth}}$ is the cumulative fraction of persons ill with anthrax who have completed Stage 1 with treatment and entered Stage 2,

$t_{\text{Stg1}}$ is the time since completing the incubation period and entering Stage 1 [days],

M is the mean time spent in Stage 1 [= 5.8 days],

S is the standard deviation of the time spent in Stage 1 [= 2.0 days],

$\mu_{\text{Stg1}}$ is the mean of the variable's natural logarithm $\left[= \ln\left(\frac{M^2}{\sqrt{S^2+M^2}}\right) = \ln\left(\frac{5.8^2}{\sqrt{2.0^2+5.8^2}}\right) = 1.702\right]$,

$\sigma_{\text{Stg1}}$ is the standard deviation of the variable's natural logarithm $\left[= \sqrt{\ln\left(\left(\frac{S}{M}\right)^2 + 1\right)} = \sqrt{\ln\left(\left(\frac{2.0}{5.8}\right)^2 + 1\right)} = 0.3352\right]$, and

$erf$ is the error function where $erf(x) = \frac{2}{\sqrt{\pi}}\int_0^x e^{-t^2}dt$.

d. The duration of Stage 2 for survivors initially treated in Stage 1 is modeled as a lognormally distributed random variable with a mean value of 1.4 days and standard deviation of 1.8 days,[36] such that the cumulative fraction of treated persons who complete Stage 2 is:

$$F_{\text{Stg2}-\text{Anth}_{S,T}}(t_{\text{Stg2}}) = \frac{1}{2} + \frac{1}{2}\left( erf\left(\frac{\ln(t_{\text{Stg2}}) - \mu_{\text{Stg2}}}{\sigma_{\text{Stg2}}\sqrt{2}}\right)\right)$$

where:

$F_{\text{Stg2}-\text{Anth}_{S,T}}$ is the cumulative fraction of persons ill with anthrax who have completed Stage 2 with treatment and entered Stage 3,

[35] Holty et al., "Systematic Review."

[36] Holty et al., "Systematic Review."

$t_{Stg2}$ is the time since completing Stage 1 and entering Stage 2 [days],

M is the mean time spent in Stage 2 [= 1.4 days],

S is the standard deviation of the time spent in Stage 2 [= 1.8 days],

$\mu_{Stg2}$ is the mean of the variable's natural logarithm $\left[= \ln\left(\frac{M^2}{\sqrt{S^2+M^2}}\right) = \ln\left(\frac{1.4^2}{\sqrt{1.8^2+1.4^2}}\right) = -0.1514\right]$,

$\sigma_{Stg2}$ is the standard deviation of the variable's natural logarithm $\left[= \sqrt{\ln\left(\left(\frac{S}{M}\right)^2 + 1\right)} = \sqrt{\ln\left(\left(\frac{1.8}{1.4}\right)^2 + 1\right)} = 0.9878\right]$, and

*erf* is the error function where $erf(x) = \frac{2}{\sqrt{\pi}}\int_0^x e^{-t^2}dt$.

e. The durations of Stages 3 and 4 for survivors initially treated in Stage 1 are modeled as constants, such that:

$$F_{\text{Stg3-Anths,T}}(t_{\text{Stg3}}) = 1, \text{ for } t_{\text{Stg3}} \geq 11 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg3}-\text{Anths,T}}$ is the cumulative fraction of persons ill with anthrax who have completed Stage 3 with treatment and entered Stage 4,

$t_{Stg3}$ is the time since completing Stage 2 and entering Stage 3 [days], and

$$F_{\text{Stg4-Anths,T}}(t_{\text{Stg4}}) = 1, \text{ for } t_{\text{Stg4}} \geq 60 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg4}-\text{Anths,T}}$ is the cumulative fraction of persons ill with anthrax who have completed Stage 4 with treatment and returned to duty, and

$t_{Stg4}$ is the time since completing Stage 3 and entering Stage 4 [days].

e. Treated non-survivors. The duration of Stage 1 for non-survivors initially treated in Stage 2 is unaffected by the treatment and is modeled the same as for untreated

individuals, namely as a lognormally distributed random variable with a mean value of 4.2 days and standard deviation of 2.3 days (see Section C126.5a).

f. The duration of Stage 2 for non-survivors initially treated in Stage 2 is modeled as a lognormally distributed random variable with a mean value of 1.5 days and standard deviation of 1.3 days,[37] such that the cumulative fraction of treated persons who complete Stage 2 is:

$$F_{\text{Stg2}-\text{Anth}_{\text{N,T}}}(t_{\text{Stg2}}) = \frac{1}{2} + \frac{1}{2}\left( erf\left( \frac{\ln(t_{\text{Stg2}}) - \mu_{\text{Stg2}}}{\sigma_{\text{Stg2}}\sqrt{2}} \right) \right)$$

where:

$F_{\text{Stg2}-\text{Anth}_{\text{N,T}}}$ is the cumulative fraction of persons ill with anthrax who have completed Stage 2 with treatment and died,

$t_{\text{Stg2}}$ is the time since completing Stage 1 and entering Stage 2 [days],

M is the mean time spent in Stage 2 [= 1.5 days],

S is the standard deviation of the time spent in Stage 2 [= 1.3 days],

$\mu_{\text{Stg2}}$ is the mean of the variable's natural logarithm $\left[= \ln\left(\frac{\text{M}^2}{\sqrt{\text{S}^2+\text{M}^2}}\right) = \ln\left(\frac{1.5^2}{\sqrt{1.3^2+1.5^2}}\right) = 0.1253\right]$,

$\sigma_{\text{Stg2}}$ is the standard deviation of the variable's natural logarithm $\left[= \sqrt{\ln\left(\left(\frac{\text{S}}{\text{M}}\right)^2 + 1\right)} = \sqrt{\ln\left(\left(\frac{1.3}{1.5}\right)^2 + 1\right)} = 0.7485\right]$, and

*erf* is the error function where $erf(x) = \frac{2}{\sqrt{\pi}}\int_0^x e^{-t^2} dt$.

[37] Holty et al., "Systematic Review."

# E. Botulism Model Parameters (Section C127)

## 1. Deletions

Footnote 138 describing the limitations on the duration of illness characterization in the absence of medical care should be deleted.

## 2. Modifications

Table C-48 should be replaced with the following:

**Table 65. Botulism Model Parameters Summary**

| Submodel | Type | Parameters |
|---|---|---|
| Effectivity | Log-probit distribution | $ED_{50}$ = 0.1 µg/man<br>Probit slope = 12.5 probits/log dose |
| Latent Period | Lognormal distribution | Median = 1 day |
| Lethality<br>Untreated | Log-probit distribution | $LD_{50}$ = 0.8 µg/man<br>Probit slope = 12.5 probits/log dose |
| Treated (antitoxin prior to Stage 3) | Rate | 0% |
| Treated (no antitoxin prior to Stage 3) | Rate | 12% |
| Duration of Illness (untreated survivors) | | |
| Stage 1 | Constant | 1 day |
| Stage 2 | Constant | 2 weeks |
| Stage 3 | Constant | 6 months |
| Duration of Illness (untreated non-survivors) | Exponential distribution | $\lambda$ = 0.318 |
| Stage 1 | 1/3 length | |
| Stage 2 | 1/3 length | |
| Stage 3 | 1/3 length | |
| Duration of Illness (treated, unventilated survivors) | | |
| Stage 1 | Constant | 1 day |
| Stage 2 | Constant | 7 days |
| Stage 3 | Constant | 9 months |

| Submodel | Type | Parameters |
|---|---|---|
| Duration of Illness (treated, ventilated non-survivors) | | |
| Stage 1 | Exponential distribution (1/3 length for untreated non-survivors) | $\lambda = 0.318$ |
| Stage 2 | Exponential distribution (1/3 length for untreated non-survivors) | $\lambda = 0.318$ |
| Stage 3 | Constant | 10 weeks |
| Duration of Illness (treated, ventilated survivors) | | |
| Stage 1 | Exponential distribution (1/3 length for untreated non-survivors) | $\lambda = 0.318$ |
| Stage 2 | Exponential distribution (1/3 length for untreated non-survivors) | $\lambda = 0.318$ |
| Stage 3 | Constant | 10 weeks |
| Stage 4 | Constant | Indefinite |

Paragraph C127.1 should be modified as follows:

*Line out:* The effective dose of botulism is modeled as a log-probit function with a probit slope of 12.9 probits/log dose …

*Line in:* The effective dose of botulism is modeled as a log-probit function with a probit slope of 12.5 probits/log dose…

Paragraph C127.3 should be replaced with:

3. Lethality. The lethal dose of untreated botulism is modeled as a log-probit function with a probit slope of 12.5 probits/log dose and an $LD_{50}$ of 0.8 μg/man (see Section A108.2). Of those that would have died without treatment (according to the untreated lethality model), 100% of those receiving antitoxin prior to Stage 3 will survive with treatment, but only 88% of those not receiving antitoxin prior to Stage 3 are modeled to survive; the remaining 12% will die despite treatment.

Paragraph C127.4 should be replaced with:

4. Injury profile. Distinct injury profiles exist for survivors and non-survivors of untreated botulism. Each injury profile characterizes the symptomatic period of illness and divides this period into three or four distinct stages, depending on clinical presentation and outcome.

- Untreated botulism. Without treatment, there are two different injury profiles, one for survivors and another for non-survivors. Each of these profiles is represented by three stages. The signs and symptoms characterizing each stage as well as the corresponding sign/symptom severity level for each stage are described in Tables C-49 and C-50.[38] The duration of each stage is determined by the "duration of illness" models discussed in the following section.
- Treated botulism. With treatment, there are three different injury profiles, one for patients who never require ventilation and all of whom survive; a second for patients who require ventilation but do not survive; and a third for patients who require ventilation and survive. The first, for unventilated survivors, is identical to the untreated survivor injury profile (although the duration of each of the stages of illness will vary with treatment). The second, for ventilated non-survivors, is identical to those for the untreated non-survivor injury profile. The third treated injury profile, for ventilated survivors, is the same as that for non-survivors but includes an additional fourth stage representing gradual recovery and convalescence. The treated injury profiles are shown in Tables C-51 through C-53. The duration of each stage is determined by the "duration of illness" models discussed in the following section.

Table C-49 should be replaced with the following:

**Table 66. Untreated Botulism Survivor Injury Profile**

| | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|
| Signs and Symptoms (S/S) | Fatigue; dry mouth; ptosis; diplopia (blurred or double vision); photophobia; dysphagia (difficulty swallowing); dysarthria (slurred speech); dysphonia; facial paralysis. | Acute symmetrical descending flaccid paralysis; progressive muscle weakness in the head and neck, followed by upper extremities and lower extremities; dysphagia and loss of gag reflex; diplopia; dysarthria; dysphonia; fatigue. | Gradual reversal of muscle paralysis. |

The title of Table C-50 should be changed to read, "Untreated Botulism Non-Survivor Injury Profile."

[38] Taken from descriptions of botulism found in S. S. Arnon et al., "Botulinum Toxin as a Biological Weapon: Medical and Public Health Management," *Journal of the American Medical Association* 285, no. 8 (February 2001): 1059–70; Z. F. Dembek et al., "Botulinum Toxin," in *Medical Aspects of Biological Warfare*, ed. Zygmunt F. Dembek, *Textbooks of Military Medicine* (Washington, DC: Department of Defense, Office of the Surgeon General, U.S. Army, Borden Institute, 2007), 337–53; and J. M. Hughes et al., "Clinical Features of Type A and B Food-borne Botulism," *Annals of Internal Medicine* 95, no. 4 (October 1981): 442–45.

The Stage 1 signs and symptoms provided in Table C-50 should be changed to read: Fatigue; dry mouth; ptosis; diplopia (blurred or double vision); photophobia; difficulty swallowing dysphagia (difficulty swallowing); dysarthria (slurred speech); dysphonia; facial paralysis.

Paragraphs C127.5.a andC127.5b should be changed to read:

a. For the untreated survivor cohort…

b. For the untreated non-survivor cohort…Each member of the untreated non-survivor cohort will spend an equal amount of time in each stage, such that the cumulative fractions of untreated non-survivors who complete each stage are...

Paragraph C127.6 should be replaced with:

6. Prophylaxis. Pre-exposure vaccination is modeled as prophylaxis against botulism (see Section A108.2). The efficacy of the prophylaxis is 1.0.

## 3. Additions

The following tables should be added to Section C128, following Table C-50, Untreated Botulism Non-Survivor Injury Profile.

**Table 67. Treated Unventilated Botulism Survivor Injury Profile**

| | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|
| Signs and Symptoms (S/S) | Fatigue; dry mouth; ptosis; diplopia; photophobia; dysphagia; dysarthria; dysphonia; facial paralysis. | Acute symmetrical descending flaccid paralysis; progressive muscle weakness in the head and neck, followed by upper extremities and lower extremities; dysphagia and loss of gag reflex; diplopia; dysarthria; dysphonia; fatigue. | Gradual reversal of muscle paralysis. |
| S/S Severity | 2 (Moderate) | 3 (Severe) | 2 (Moderate) |
| Outlook | Individual will progress to Stage 2. | Individual will progress to Stage 3. | Individual will convalesce and return to duty. |

**Table 68. Treated Ventilated Botulism Non-Survivor Injury Profile**

| | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|
| Signs and Symptoms (S/S) | Fatigue; dry mouth; ptosis; diplopia; photophobia; dysphagia; dysarthria; dysphonia; facial paralysis. | Acute symmetrical descending flaccid paralysis; progressive muscle weakness in the head and neck, followed by upper extremities and lower extremities; dysphagia and loss of gag reflex; diplopia; dysarthria; dysphonia; fatigue. | Acute symmetrical descending flaccid paralysis; paralysis in respiratory muscles and upper and lower extremities; respiratory failure. |
| S/S Severity | 2 (Moderate) | 3 (Severe) | 4 (Very Severe) |
| Outlook | Individual will progress to Stage 2. | Progression to Stage 3. | Death. |

**Table 69. Treated Ventilated Botulism Survivor Injury Profile**

| | Stage 1 | Stage 2 | Stage 3 | Stage 4 |
|---|---|---|---|---|
| Signs and Symptoms (S/S) | Fatigue; dry mouth; ptosis; diplopia; photophobia; dysphagia; dysarthria; dysphonia; facial paralysis. | Acute symmetrical descending flaccid paralysis; progressive muscle weakness in the head and neck, followed by upper extremities and lower extremities; dysphagia and loss of gag reflex; diplopia; dysarthria; dysphonia; fatigue. | Acute symmetrical descending flaccid paralysis; paralysis in respiratory muscles and upper and lower extremities; respiratory failure. | Gradual reversal of muscle paralysis. |
| S/S Severity | 2 (Moderate) | 3 (Severe) | 4 (Very Severe) | 2 (Moderate) |
| Outlook | Individual will progress to Stage 2. | Individual will progress to Stage 3. | Individual will progress to Stage 4. | Individual will convalesce. |

The following text should be inserted as paragraphs C127.5c through C127.5e:

c. For the treated, unventilated survivor cohort, the duration of illness for each stage of illness is modeled as constant, such that

$$F_{\text{Stg1-Bot}_{S,T,U}}(t_{\text{Stg1}}) = 1, \text{for } t_{\text{Stg1}} \geq 1 \text{ day}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg1-Bot}_{S,T,U}}$ is the cumulative fraction of survivors with botulism who have completed Stage 1 with treatment (unventilated) and entered Stage 2 of the disease,

$t_{\text{Stg1}}$ is the time since completing the latent period [days],

$$F_{\text{Stg2-Bot}_{S,T,U}}(t_{\text{Stg2}}) = 1, \text{for } t_{\text{Stg2}} \geq 7 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg2-Bot}_{S,T,U}}$ is the cumulative fraction of survivors with botulism who have completed Stage 2 with treatment (unventilated) and entered Stage 3 of the disease,

$t_{\text{Stg2}}$ is the time since completing Stage 1 [days], and

$$F_{\text{Stg3-Bot}_{S,T,U}}(t_{\text{Stg3}}) = 1, \text{for } t_{\text{Stg3}} \geq 270 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg3-Bot}_{S,T,U}}$ is the cumulative fraction of survivors with botulism who have completed Stage 3 with treatment (unventilated) and returned to duty, and

$t_{\text{Stg3}}$ is the time since completing Stage 2 [days].[39]

d. For the treated, ventilated non-survivor cohort, the durations of each of the first two stages of illness are modeled the same as for untreated non-survivors for illness, namely as a third of the total untreated duration of illness (which is modeled as an exponentially

[39] Derived from data in Herrero et al., "Experimental Botulism in Monkeys"; and F. W. Oberst et al., *Botulinum Antitoxin as a Therapeutic Agent in Monkeys with Experimental Botulism* (Edgewood, MD: U.S. Army Edgewood Arsenal Chemical Research and Development Laboratories, 1965).

distributed random variable with parameter λ = 0.318) (see Section C127.5b). The third stage of illness for treated, ventilated non-survivors is modeled as constant, such that

$$F_{\text{Stg3-Bot}_{\text{N-S,T,V}}}(t_{\text{Stg3}}) = 1, \text{for } t_{\text{Stg3}} \geq 70 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg3-Bot}_{\text{N-S,T,V}}}$ is the cumulative fraction of survivors with botulism who have completed Stage 3 with treatment (ventilated) and died from the disease, and

$t_{\text{Stg3}}$ is the time since completing Stage 2 [days].

e. For the treated, ventilated survivor cohort, the durations of each of the first three stages of illness are modeled the same as for treated, ventilated non-survivors (see Section C127.5d). The fourth stage of illness is modeled to last for months or years, so there is no specific end point to this stage of illness. Individuals in this cohort are assumed to be convalescent indefinitely and will not return to duty.

## F. Venezuelan Equine Encephalitis (VEE) Model Parameters (Section C128)

### 1. Deletions

The last sentence of paragraph C128.4 should be removed, beginning with the text "Since the casualty estimation methodology does not model recovery…"

## G. Brucellosis Model Parameters (Section C129)

The specific distributions and parameters chosen for each of the five submodels for the five additional noncontagious biological agents are presented in the following five sections, which should be added to Annex C, following Section C128 "VEE Model Parameters." Subsequent sections should be renumbered accordingly.

### 1. Additions

The following text should be added as Section C129, Brucellosis Model Parameters.

**Table 70. Brucellosis Model Parameters Summary Table**

| Submodel | Type | Parameters |
|---|---|---|
| Infectivity | Lognormal distribution | $ID_{50}$ = 949 organisms, Probit slope = 2.58 probits/log(dose) |
| Incubation period | Weibull distribution | α = 1.72, β = 10.2 |
| Lethality, if symptomatic | Rate | 0% |
| Duration of illness | | |
| Total duration (untreated) | Gamma distribution | k = 3.97, θ = 2.54 |
| Abrupt onset Stage 1 (untreated) | Same as total duration (untreated) | |
| Insidious onset Stage 1 (untreated) | Gamma distribution | k = 0.827, θ = 5.32 |
| Insidious onset Stage 2 (untreated) | Total duration(untreated) minus insidious onset Stage 1 (untreated) | |
| Abrupt onset Stage 1 (treated) | Constant | 2 weeks |
| Insidious onset total duration(treatment initiated in Stage 1) | Constant | 2 weeks |
| Insidious onset Stage 1 (treatment initiated in Stage 2) | Gamma distribution | k = 0.827, θ = 5.32 |
| Insidious onset Stage 2 (treatment initiated in Stage 2) | Constant | 2 weeks |

1. Infectivity. The infectious dose of *Brucella* organisms is modeled as a log-probit function with a probit slope of 2.58 probits/log(dose) and an $ID_{50}$ of 949 organisms (see Section A108.4).

2. Incubation period. The time spent in the incubation period for brucellosis is modeled as a random variable with a Weibull distribution who's CDF is:

$$F_{\text{Inc-Bruc}}(t) = 1 - e^{-(t/\beta)^{\alpha}}$$

where:

$F_{\text{Inc-Bruc}}$ is the cumulative fraction of persons with brucellosis who have completed the incubation period and entered Stage 1 of the disease,

t is the time post-exposure [weeks],

α is the shape parameter [= 1.72], and

β is the scale parameter [= 10.2].[40]

3. Lethality. Brucellosis is modeled as non-lethal. Therefore, $p_{\text{f-Bruc}}(d_n) = 0$ for all values of $d_n$.

4. Injury profile. Distinct brucellosis injury profiles exist for those experiencing an abrupt symptom onset and those experiencing an insidious onset. Each injury profile characterizes the symptomatic period of illness and divides this period into different stages. For abrupt onset brucellosis, there is only one stage, whereas insidious onset brucellosis is modeled with two stages of illness. The signs and symptoms characterizing each stage as well as the corresponding sign/symptom severity level for each stage are described in Tables C-xx and C-xx.[41] The duration of each stage is determined by the "duration of illness" models discussed in the following section.

**Table 71. Brucellosis Abrupt Onset Injury Profile**

| | **Stage 1** |
|---|---|
| Signs and Symptoms (S/S) | Fever, sweats, chills, headache, malaise, fatigue, arthralgia, myalgia, anorexia, weight loss. |
| S/S Severity | 3 (Severe) |
| Outlook | Individual will likely recover from illness. |

[40] Derived from data in Robert W. Trever et al., "Brucellosis I. Laboratory-Acquired Acute Infection," *American Medical Association Archives of Internal Medicine* 103, no. 3 (March 1959): 381–97; Young, "Human Brucellosis"; Jaime E. Olle-Goig and Jaime Canela-Soler, "An Outbreak of *Brucella melitensis* by Airborne Transmission Among Laboratory Workers," *American Journal of Public Health* 77, no. 3 (March 1987): 335–38; Abdul Karim Al-Aska and Abdul Hamid Chagla, "Laboratory-Acquired Brucellosis," *Journal of Hospital Infection* 14, no. 1 (1989): 70–71; J. Staszkiewicz et al., "Outbreak of *Brucella melitensis* among Microbiology Laboratory Workers in a Community Hospital," *Journal of Clinical Microbiology* 29, no. 2 (February 1991): 287–90; E. Gruner et al., "Brucellosis: An Occupational Hazard for Medical Laboratory Personnel: Report of Five Cases," *Infection* 22, no. 1 (1994): 33–36; Pier-Luigi Fiori et al., "*Brucella abortus* Infection Acquired in Microbiology Laboratories," *Journal of Clinical Microbiology* 38, no. 5 (May 2000): 2005–6; Ziad A. Memish and M. W. Mah, "Brucellosis in Laboratory Workers at a Saudi Arabian Hospital," *American Journal of Infection Control* 29, no. 1 (2001): 48–52; Stephanie Noviello et al., "Laboratory-Acquired Brucellosis,"*Emerging Infectious Diseases* 10, no. 10 (2004): 1848–50; Sophie Robichaud et al., "Prevention of Laboratory-Acquired Brucellosis," *Clinical Infectious Diseases* 38, no. 12 (June 15, 2004): e119–22; and Tuna Demirdal and Nese Demirturk, "Laboratory-Acquired Brucellosis," *Annals Academy of Medicine* 37, no. 1 (2008): 86–87.

[41] Derived from descriptions of brucellosis found in Bret K. Purcell, David L. Hoover, and Arthur M. Friedlander, "Brucellosis," in *Medical Aspects of Biological Warfare*, ed. Zygmunt F. Dembek, *Textbooks of Military Medicine* (Washington, DC: Department of Defense, Office of the Surgeon General, U.S. Army, Borden Institute, 2007), 185–98; and Anno et al., *AMedP-8 (Biological) Methods Report*.

**Table 72. Brucellosis Insidious Onset Injury Profile**

| | Stage 1 | Stage 2 |
|---|---|---|
| Signs and Symptoms (S/S) | Fever, malaise. | Fever, sweats, chills, headache, malaise, fatigue, arthralgia, myalgia, anorexia, weight loss. |
| S/S Severity | 1 (Mild) | 3 (Severe) |
| Outlook | Individual will progress to Stage 2. | Individual will likely recover from illness. |

5. Duration of illness.

a. Without treatment, the total duration of illness is modeled the same for both abrupt and insidious onset brucellosis cases. The total symptomatic period for untreated brucellosis is modeled as a gamma-distributed random variable with median and mean values of 9.2 and 10.1 weeks, respectively, such that the cumulative fraction of untreated persons becoming asymptomatic is:

$$F_{\text{Tot-Bruc}_{\text{Abr,U}}}(t) = F_{\text{Tot-Bruc}_{\text{Ins,U}}}(t) = \sum_{i=k}^{\infty} \frac{(t/\theta)^i}{i!} e^{-t/\theta}$$

where:

$F_{\text{Tot-Bruc}_{\text{Abr,U}}}$ is the cumulative fraction of persons with abrupt onset brucellosis who become asymptomatic without treatment,

$F_{\text{Tot-Bruc}_{\text{Ins,U}}}$ is the cumulative fraction of persons with insidious onset brucellosis who become asymptomatic without treatment,

t is the total duration of illness [weeks],

k is the shape parameter [= 3.97], and

θ is the scale parameter [= 2.54].[42]

b. Likewise, the untreated duration of the first stage of insidious onset brucellosis is modeled as a gamma-distributed random variable with median and mean values of 2.8 and 4.4

[42] Derived from data in Ruth Gilbert and Marion B. Coleman, "Undulant Fever in New York State," *Journal of Infectious Diseases* 54, no. 3 (May–June, 1934): 305–12; George E. Atwood and H. E. Hasseltine, "Undulant Fever in Ware County, Ga," *Public Health Reports (1896–1970)* 45, no. 24 (June 13, 1930): 1343–54; and Geoffrey Shera, "Four Cases of Undulant Fever," *British Medical Journal* 2, no. 3691 (October 3, 1931): 605–7.

weeks, respectively, such that the cumulative fraction of untreated persons who complete Stage 1 is:

$$F_{\text{Stg1-Bruc}_{\text{Ins,U}}}(t) = \sum_{i=k}^{\infty} \frac{(t/\theta)^i}{i!} e^{-t/\theta}$$

where:

$F_{\text{Stg1-Bruc}_{\text{Ins,U}}}$ is the cumulative fraction of ill persons with insidious onset brucellosis who have completed Stage 1 without treatment and entered Stage 2,

t is the time since completing the incubation period and entering Stage 1 [weeks],

k is the shape parameter [= 0.827], and

θ is the scale parameter [= 5.32].[43]

c. The second stage of illness for untreated insidious onset brucellosis is modeled as the difference between the total duration of illness and the duration of Stage 1.

d. With treatment, the duration of illness for both abrupt and insidious onset cases is modeled as a constant two weeks from the start of medical care. The total duration of abrupt onset brucellosis is, therefore, modeled as a constant, such that:

$$F_{\text{Tot-Bruc}_{\text{Abr,T}}}(t_{\text{Tot}}) = 1, \text{ for } t_{\text{Tot}} \geq 14 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Tot}-\text{Bruc}_{\text{Abr,T}}}$ is the cumulative fraction of persons ill with abrupt onset brucellosis who have completed Stage 1 with treatment and returned to duty, and

$t_{\text{Tot}}$ is the time since completing the incubation period and entering Stage 1 [days].

e. Similarly, if treatment is initiated in the first stage of insidious onset brucellosis (which occurs only if the casualty criterion is WIA(1), since symptomatic individuals would not enter the medical system until Stage 2 for a casualty criterion of WIA(2) or WIA(3)), then the total duration (Stages 1 and 2 combined) of insidious onset brucellosis is also modeled as a constant, such that:

[43] Derived from data in Gilbert and Coleman, "Undulant Fever in New York State"; Atwood and Hasseltine, "Undulant Fever in Ware County, Ga"; Shera, "Four Cases of Undulant Fever"; and A. V. Hardy et al., "Undulant Fever," *Public Health Reports* 45, no. 41 (October 10, 1930): 2433–74.

$$F_{\text{Tot-Bruc}_{\text{Ins,T}}}(t_{\text{Tot}}) = 1, \text{ for } t_{\text{Tot}} \geq 14 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Tot}-\text{Bruc}_{\text{Ins,T}}}$ is the cumulative fraction of persons ill with insidious onset brucellosis who have completed Stage 1 with treatment and returned to duty, and

$t_{\text{Tot}}$ is the time since completing the incubation period and entering Stage 1 [days].

f. If treatment is first initiated in Stage 2 of insidious onset brucellosis, then the duration of Stage 1 is modeled the same as for untreated individuals, namely as a gamma distributed random variable with a shape parameter k = 0.827 and scale parameter θ = 5.32 (see Section C129.5b).

c. The duration of Stage 2 of insidious onset brucellosis if treatment is initiated in Stage 2 is modeled as a constant such that:

$$F_{\text{Stg2-Bruc}_{\text{Ins,T}}}(t_{\text{Tot}}) = 1, \text{ for } t_{\text{Stg2}} \geq 14 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg2}-\text{Bruc}_{\text{Ins,T}}}$ is the cumulative fraction of persons ill with insidious onset brucellosis who have completed Stage 2 with treatment and returned to duty, and

$t_{\text{Stg2}}$ is the time since completing Stage 1 and entering Stage 2 [days].

6. Prophylaxis. No prophylaxis is modeled for brucellosis.

## H. Glanders Model Parameters (Section C130)

### 1. Additions

The following text should be added as Section C130, Glanders Model Parameters.

**Table 73. Glanders Model Parameters Summary Table**

| Submodel | Type | Parameters |
|---|---|---|
| Infectivity | Lognormal distribution | $ID_{50}$ = 24.5 CFU<br>Probit slope = 1.93 probits/log(dose) |
| Incubation period | Lognormal distribution | Mean = 8.29 days<br>Standard deviation = 13.0 |
| Lethality, if symptomatic | | |
| Untreated | Rate | 70% |
| Treated | Rate | 0% |
| Duration of illness, Untreated | | |
| Total | Weibull distribution | α = 1.90<br>β = 26.0 |
| Stage 1 | Rate | 30% of total duration |
| Stage 2 | Rate | 45% of total duration |
| Stage 3 | Rate | 25% of total duration |
| Duration of illness, Treated | | |
| Stage 1 | Constant | 7 days |
| Stage 2 | Constant | 14 days |
| Stage 3 | Constant | 10 weeks |

1. Infectivity. The infectious dose of *Burkholderia mallei* is modeled as a log-probit function with a probit slope of 1.93 probits/log(dose) and an $ID_{50}$ of 24.5 CFU (see Section A108.5).

2. Incubation period. The time spent in the incubation period for glanders is modeled as a random variable with a lognormal distribution whose CDF is:

$$F_{\text{Inc-Glan}}(t) = \frac{1}{2} + \frac{1}{2} erf\left[\frac{\ln(t) - \mu}{\sigma\sqrt{2}}\right]$$

where:

$F_{\text{Inc-Glan}}$ is the fraction of persons exposed to a dose d of *Burkholderia mallei* at Icon *n* who become ill (exposed and infected),

t is the time post-exposure [days],

M is the mean incubation period [=8.29 days],

S is the standard deviation of the incubation periods [=13.0 days],

μ is the mean of the variable's natural logarithm [$= \ln\left(\frac{M^2}{\sqrt{S^2+M^2}}\right) = \ln\left(\frac{8.29^2}{\sqrt{13.0^2+8.29^2}}\right) = 1.49$],

σ is the standard deviation of the variable's natural logarithm [$= \sqrt{\ln\left(\left(\frac{S}{M}\right)^2 + 1\right)}$ $= \sqrt{\ln\left(\left(\frac{13.0}{8.29}\right)^2 + 1\right)} = 1.11$], and

*erf* is the error function where $erf(x) = \frac{2}{\sqrt{\pi}}\int_0^x e^{-t^2}\,dt$.[44]

3. Lethality. Untreated glanders is modeled with a case fatality rate of 70%. Therefore $p_{\text{f-Glan}}(d_n) = 0.70 * p_{\text{E-Glan}}(d_n)$. With treatment, all glanders patients are expected to survive. Therefore $p_{\text{f-Glan}}(d_n) = 0$.

4. Injury profile. Without treatment, the injury profiles for survivors and non-survivors of glanders are exactly the same through Stage 3. After progressing through Stage 3, the survivors enter a fourth stage of illness that is a milder, chronic form of glanders, while the non-survivors die. With treatment, since all patients are expected to survive there is only a single injury profile; this consists of three stages, of which the third and final stage is an extended period of convalescence. For all three glanders injury profiles, the signs and symptoms characterizing each stage, as well as the corresponding sign/symptom severity level for each stage, are described in Tables C-xx and C-xx.

[44] Derived from data in Elliotson, "On the Glanders in the Human Subject"; John Elliotson, "Additional Facts Respecting Glanders in the Human Subject," *Journal of the Royal Society of Medicine* 18, Pt. 1 (1833): 201–7; Cox, "Case of Acute Glanders in the Human Subject: With Remarks"; Stewart, "Pyæmic Glanders in the Human Subject. Report of a Recent Case of Laboratory Origin Terminating in Recovery," Robins, *A Study of Chronic Glanders in Man with Report of a Case: Analysis of 156 Cases Collected from the Literature and an Appendix of the Incidence of Equine and Human Glanders in Canada*; Pilcher, "Glanders in the Human Subject"; Hunting, *Glanders: A Clinical Treatise*; Bernstein and Carling, "Observations on Human Glanders"; Herold and Erickson, "Human Glanders: Case Report"; Calderon Howe and Winston R. Miller, "Human Glanders: Report of Six Cases," *Annals of Internal Medicine* 26, no. 1 (1947): 93–115; and Arjun Srinivasan et al., "Glanders in a Military Research Microbiologist," *New England Journal of Medicine* 345 (2001): 256–58.

**Table 74.Untreated Glanders Injury Profile**

| | Stage 1 | Stage 2 | Stage 3 | Stage 4 (survivors) | Stage 4 (non-survivors) |
|---|---|---|---|---|---|
| Signs and Symptoms (S/S) | Localized pain and inflammation, fever, swelling, chills, and phlegmon. | Cough, suppuration, red streaks, papular eruption nasal discharge, abscess, pain, and ulcerations. | Diarrhea, emaciation, pustules, necrosis, dyspnea, and delirium. | Chronic glanders. | None (dead). |
| S/S Severity | 1 (Mild) | 2 (Moderate) | 3 (Severe) | 2 (Moderate) | |
| Outlook | Individual will progress to Stage 2. | Individual will progress to Stage 3. | Individual will progress to Stage 4. | Individual will likely recover after a prolonged illness. | Individual will likely die without treatment. |

**Table 75.Treated Glanders Injury Profile**

| | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|
| Signs and Symptoms (S/S) | Low-grade fever, malaise, headache, myalgia, swollen lymph nodes, chest pain. | High fever, headache, myalgia; development of pulmonary symptoms, including pneumonia, pulmonary abscesses, pleuritis, and pleural effusion. | Resolution of fever and gradual clearing of pulmonary infection. |
| S/S Severity | 2 (Moderate) | 4 (Very Severe) | 2 (Moderate) |
| Outlook | Individual will progress to Stage 2. | Individual will progress to Stage 3. | Individual will return to duty. |

5. Duration of illness.

a. Untreated. Since chronic effects are not considered in this document, the untreated survivor duration of illness model spans only the acute phase of illness, i.e., the first three stages. Once survivors have progressed through Stage 3 and entered the chronic stage, they remain there for an indeterminate length of time. The untreated "total" duration of illness, excluding the survivor Stage 4, is modeled to be the same as the total duration of illness for untreated non-survivors, who progress through the same three stages as untreated survivors before they die. The mean duration of the first three stages is modeled as a random variable with a Weibull distribution with a mean value of 23.1 days and a standard deviation of 12.7 days. The cumulative fraction of persons who complete Stage 3 is:

$$F_{\text{Stg3-Glan}}(t) = 1 - e^{-(t/\beta)^{\alpha}}$$

where:

$F_{\text{Stg3-Glan}}$ is the cumulative fraction of persons with glanders who have completed Stage 3 without treatment,

t is the time since completing the incubation period and entering Stage 1 [days],

α is the shape parameter [= 1.90], and

β is the scale parameter [= 26.0].[45]

For both untreated survivors and non-survivors, the time spent in each of the three stages is modeled to be proportional to the total time spent in all three stages. Individuals are modeled to spend 30% of the total duration in Stage 1, 45% of the total duration in Stage 2, and 25% of the total duration in Stage 3.[46]

b. Treated. With treatment, the durations of each stage of illness are modeled as constants, such that:

$$F_{\text{Stg1-Glan}_{S,T}}(t_{\text{Stg1}}) = 1, \text{for } t_{\text{Stg1}} \geq 7 \text{ days}$$

$$\text{else} = 0$$

45 Derived from data in Elliotson, "On the Glanders in the Human Subject"; Hamerton, "Cases of Acute Glanders in the Human Subject, Terminating Fatally"; Cox, "Case of Acute Glanders in the Human Subject: With Remarks"; Mason, "Case of Glanders in Man"; Stewart, "Pyæmic Glanders in the Human Subject. Report of a Recent Case of Laboratory Origin Terminating in Recovery"; Robins, *A Study of Chronic Glanders in Man with Report of a Case: Analysis of 156 Cases Collected from the Literature and an Appendix of the Incidence of Equine and Human Glanders in Canada*; Pilcher, "Glanders in the Human Subject"; Hunting, *Glanders: A Clinical Treatise*; Bernstein and Carling, "Observations on Human Glanders;" Sobol, "A Case of Chronic Nasal Glanders"; Burgess, "Chronic Glanders"; Herold and Erickson, "Human Glanders: Case Report"; and Howe and Miller, "Human Glanders: Report of Six Cases."

46 Derived from data in Hamerton, "Cases of Acute Glanders in the Human Subject, Terminating Fatally"; Cox, "Case of Acute Glanders in the Human Subject: With Remarks"; Mason, "Case of Glanders in Man"; Gordon Sharp, "The Morbid Anatomy of the Bones in Chronic Glanders in the Human Subject," *Journal of Anatomy* 29, Pt. 4 (1895): 492–93; Stewart, "Pyæmic Glanders in the Human Subject. Report of a Recent Case of Laboratory Origin Terminating in Recovery"; Robins, *A Study of Chronic Glanders in Man with Report of a Case: Analysis of 156 Cases Collected from the Literature and an Appendix of the Incidence of Equine and Human Glanders in Canada*; Pilcher, "Glanders in the Human Subject"; Hunting, *Glanders: A Clinical Treatise*; Bernstein and Carling, "Observations on Human Glanders"; Sobol, "A Case of Chronic Nasal Glanders"; Burgess, "Chronic Glanders"; Herold and Erickson, "Human Glanders: Case Report"; Bridget Carr Gregory and David M. Waag, "Glanders," in *Medical Aspects of Biological Warfare*, ed. Zygmunt F. Dembek, *Textbooks of Military Medicine* (Washington, DC: Department of Defense, Office of the Surgeon General, U.S. Army, Borden Institute, 2007), 121–46; and Anno et al., *AMedP-8 (Biological) Methods Report*.

where:

$F_{\text{Stg1-Glan}_{S,T}}$ is the cumulative fraction of survivors with glanders who have completed Stage 1 with treatment and entered Stage 2 of the disease,

$t_{\text{Stg1}}$ is the time since completing the incubation period [days],

$$F_{\text{Stg2-Glan}_{S,T}}(t_{\text{Stg2}}) = 1, \text{for } t_{\text{Stg2}} \geq 14 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg2-Glan}_{S,T}}$ is the cumulative fraction of survivors with glanders who have completed Stage 2 with treatment and entered Stage 3 of the disease,

$t_{\text{Stg2}}$ is the time since completing Stage 1 [days], and

$$F_{\text{Stg3-Glan}_{S,T}}(t_{\text{Stg3}}) = 1, \text{for } t_{\text{Stg3}} \geq 70 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg3-Glan}_{S,T}}$ is the cumulative fraction of survivors with glanders who have completed Stage 3 with treatment and returned to duty, and

$t_{\text{Stg3}}$ is the time since completing Stage 2 [days].[47]

6. Prophylaxis. No prophylaxis is modeled for glanders.

[47] Derived from data in Bridget Carr Gregory and David M. Waag, "Glanders," in *Medical Aspects of Biological Warfare*, ed. Zygmunt F. Dembek, *Textbooks of Military Medicine* (Washington, DC: Department of Defense, Office of the Surgeon General, U.S. Army, Borden Institute, 2007), 121–46.

# I. Q Fever Model Parameters (Section C131)

## 1. Additions

The following text should be added as Section C131, Q Fever Model Parameters.

**Table 76. Q Fever Model Parameters Summary Table**

| Submodel | Type | Parameters |
|---|---|---|
| Infectivity | Lognormal distribution | $ID_{50}$ = 30 organisms<br>Probit slope = 0.782 probits/log(dose) |
| Incubation period | Log-linear function | a = 19.6, b = -1.88 |
| Lethality, if symptomatic | Rate | 0% |
| Duration of illness | Lognormal distribution | Mean = 12.1 days<br>Standard deviation = 6.66 days |

1. Infectivity. The infectious dose of *Coxiella burnetii* is modeled as a log-probit function with a probit slope of 0.782 probits/log(dose) and an $ID_{50}$ of 30 organisms (see Section A108.6).

2. Incubation period. The time spent in the incubation period for Q fever is modeled as a function of the inhaled dose. The log-linear function that represents the incubation period is:

$$t = a + b*\log(d)$$

where:

t is the time post-exposure [days],

d is the dose of *Coxiella burnetii* [organisms],

a = 19.6, and

b = -1.88.[48]

3. Lethality. Q fever is modeled as non-lethal. Therefore $p_{\text{f-Q-Fev}}(d_n) = 0$ for all values of $d_n$.

4. Injury profile. Q fever has only one injury profile—for survivors—that characterizes the symptomatic period of illness as a single stage. Treatment for Q fever will shorten the duration of illness but not change the associated signs and symptom. The signs and symptoms characterizing Q fever, as well as the corresponding sign/symptom severity level, are described in Table C-xx.

[48] Anno et al., *AMedP-8 (Biological) Methods Report*, 130, derived from data in Tigertt and Benenson, "Studies on Q Fever in Man."

**Table 77. Q Fever Injury Profile**

| | Stage 1 |
|---|---|
| Signs and Symptoms (S/S) | Fever, chills, headache, myalgia.<br>Pneumonia; hepatitis. |
| S/S Severity | 2 (Moderate) |
| Outlook | Patient is likely to recover. |

5. Duration of illness.

a. Untreated. Duration of illness for untreated Q fever is modeled as a lognormally distributed random variable with a mean value of 12.1 days and a standard deviation of 6.66 days, such that the cumulative fraction of persons who complete Stage 1 (the entire illness) is:

$$F_{\text{Stg1-Q-Fev}}(t) = \frac{1}{2} + \frac{1}{2} erf\left[\frac{\ln(t) - \mu}{\sigma\sqrt{2}}\right]$$

where:

$F_{\text{Stg1-Q-Fev}}$ is the fraction of persons ill with Q fever who have completed Stage 1,

t is the time post-exposure [days],

M is the mean incubation period [= 12.1 days],

S is the standard deviation of the incubation periods [= 6.66 days],

μ is the mean of the variable's natural logarithm [$= \ln\left(\frac{M^2}{\sqrt{S^2+M^2}}\right) = \ln\left(\frac{12.1^2}{\sqrt{6.66^2+12.1^2}}\right)$ = 2.36],

σ is the standard deviation of the variable's natural logarithm [$= \sqrt{\ln\left(\left(\frac{S}{M}\right)^2 + 1\right)}$ $= \sqrt{\ln\left(\left(\frac{6.66}{12.1}\right)^2 + 1\right)}$ = 0.514], and

*erf* is the error function where $erf(x) = \frac{2}{\sqrt{\pi}}\int_0^x e^{-t^2}\, dt$.[49]

b. Treated. With treatment, the duration of illness for treated Q fever is modeled as a constant, such that:

[49] Derived from data in E. H. Derrick, "The Course of Infection with *Coxiella burneti*," *Medical Journal of Australia* 1, no. 21 (May 26, 1973): 1051–57; and J. W. Hornibrook and K.R. Nelson, "An Institutional Outbreak of Pneumonitis I. Epidemiological and Clinical Studies," *Public Health Reports* 55, no. 43 (October 25, 1940): 1936–44.

$$F_{\text{Stg1-Q-Fev}}(t) = 1, \text{for } t_{\text{Stg1}} \geq 4 \text{ days}$$

where:

$F_{\text{Stg1-Q-Fev}}$ is the fraction of treated Q fever patients who have completed Stage 1 of the disease, and

$t_{\text{Stg1}}$ is the time since completing the incubation period [days].

6. Prophylaxis. Pre-exposure vaccination is modeled as prophylaxis against Q fever (see Section A108.6). The efficacy of prophylaxis is 1.0.

## J. Staphylococcal Enterotoxin B (SEB) Model Parameters (Section C132)

### 1. Additions

The following text should be added as Section C132, SEB Model Parameters.

**Table 78. SEB Model Parameters Summary Table**

| Submodel | Type | Parameters |
|---|---|---|
| Infectivity | Lognormal distribution | $ED_{50}$ = 0.026 μg/man;<br>Probit slope = 2.44 probits/log(dose) |
| Lethality | Lognormal distribution | $LD_{50}$ = 1.40 μg/man;<br>Probit slope = 2.44 probits/log(dose) |
| Incubation period | Constant | 9 hours |
| Duration of illness | | |
| Stage 1 | Linear function | a = 6.10, b = 371<br>Maximum = 192 hours |
| Stage 2 | Constant | One week |

1. Effectivity. The effective dose of SEB is modeled as a log-probit function with a probit slope of 2.44 probits/log(dose) and an $ED_{50}$ of 0.026 μg/man (see Section A108.7).

2. Latent period. The time spent in the latent period for SEB intoxication is modeled as a constant value of nine hours for all persons who will become ill.[50]

3. Lethality. The lethal dose of SEB is modeled as a log-probit function with a probit slope of 2.44 probits/log(dose) and an $LD_{50}$ of 1.4μg/man (see Section A108.7). The lethality of SEB does not change with treatment.

[50] Derived from data in Sheldon Sidell, "Human Clinical Syndrome Associated with Accidental Exposure to Aerosolized Staphylococcal Enterotoxin B," in *Special Report to Commission on Epidemiological Survey*, ed. H. G. Dangerfield, No. 65-FDS-1662 (Ft. Detrick, Frederick, MD, April 1965), 25–52.

4. Injury profile. Distinct injury profiles exist for survivors and non-survivors of SEB intoxication. Each injury profile characterizes the symptomatic period of illness and divides this period into either one (for non-survivors) or two (for survivors) stages.. The signs and symptoms characterizing each stage, as well as the corresponding sign/symptom severity level for each stage, are described in Tables C-xx and C-xx.[51] There are no medical countermeasures or specific treatments for SEB that would change any of the components of SEB human response; therefore, Tables C-xx and C-xx apply to both treated and untreated cases. The duration of each stage is determined by the "duration of illness" models discussed in the following section.

**Table 79. SEB Survivor Injury Profile, Treated or Untreated**

| | Stage 1 | Stage 2 |
|---|---|---|
| Signs and Symptoms (S/S) | Cough, headache, chest pain, myalgia, elevated temperature, vomiting, nausea, and anorexia. | Non-productive cough. |
| S/S Severity | 3 (Severe) | 1 (Mild) |
| Outlook | Individual will progress to Stage 2. | Individual will likely recover. |

**Table 80. SEB Non-Survivor Injury Profile, Treated or Untreated**

| | Stage 1 |
|---|---|
| Signs and Symptoms (S/S) | Cough, headache, chest pain, myalgia, elevated temperature, vomiting, nausea, and anorexia. |
| S/S Severity | 3 (Severe) |
| Outlook | Individual will likely die without treatment. |

5. Duration of illness.

a. The time spent in Stage 1 is the same in both treated and untreated cases. It is also modeled to be the same for both survivors and non-survivors and is a function of the inhaled dose. The linear function that represents the duration of Stage 1 is:

$$t_{Stg1} = a + b*d$$

where:

[51] Rusnak et al., "Laboratory Exposures to Staphylococcal Enterotoxin B."

$t_{Stg1}$ is the time since completing the latent period and entering Stage 1 [days],

d is the dose of SEB[μg/man], for d<= 0.5 μg/man;

a =6.10, and

b = 371.[52]

At doses above 0.5 μg, $t_{Stg1}$=192 hours (8 days).

b. The time spent in Stage 2 for survivors is independent of treatment and is modeled as a constant value of one week.[53]

6. Prophylaxis. No prophylaxis is modeled for SEB.

## K. Tularemia Model Parameters (Section C133)

### 1. Additions

The following text should be added as Section C133, Tularemia Model Parameters.

[52] Anno et al., *AMedP-8 (Biological) Methods Report*, 94.

[53] Derived from data in Sidell, "Human Clinical Syndrome."

**Table 81. Tularemia Model Parameters Summary Table**

| Submodel | Type | Parameters |
|---|---|---|
| Infectivity | Lognormal distribution | $ID_{50}$ = 10 organisms<br>Probit slope = 1.90 probits/log(dose) |
| Incubation period | Log-linear function | a = 6.54, b = -0.821<br>(for dose < 106,064 organisms) |
| | Log-quadratic function | e = 11.0, f = -2.59, g = 0.176<br>(106,064 organisms ≤ dose <9,019,577 organisms) |
| | Constant | 1.5 days<br>(dose ≥ 9,019,577 organisms) |
| Lethality, if symptomatic | | |
| Untreated | Rate | 75% |
| Treated | Rate | 0% |
| Duration of illness (Untreated non-survivor) | | |
| Stage 1 | Constant | 9 days |
| Stage 2 | Constant | 6 days |
| Duration of illness (Untreated survivor) | | |
| Stage 1 | Constant | 12 days |
| Stage 2 | Constant | 28 days |
| Stage 3 | Constant | 12 weeks |
| Duration of illness (Treated survivor) | | |
| Stage 1 | Constant | 4 days |
| Stage 2 | Constant | 6 days |

1. Infectivity. The infectious dose of *Francisella tularensis* is modeled as a log-probit function with a probit slope of 1.90 probits/log(dose) and an $ID_{50}$of 10 organisms (see Section A108.8).

2. Incubation period. The time spent in the incubation period for tularemia is modeled as a piece-wise function of the dose.

a. The log-linear function that represents the incubation period for doses less than 106,064 organisms is:

$$t = a + b*\log(d)$$

where:

t is the time post-exposure [days],

d is the dose of *Francisella tularensis*[organisms],

a =6.54, and

b = -0.821.[54]

b. The quadratic function that represents the incubation period for doses greater than or equal to 106,064 organisms but less than 9,019,577 organisms is:

$$t = e + f*\log(d) + g*\log(d)^2$$

where:

t is the time post-exposure [days],

d is the dose of *Francisella tularensis* [organisms],

e = 11.0,

f=-2.59, and

g= 0.176.[55]

c. For doses greater than or equal to 9,019,577organisms, the incubation period is modeled as a constant 1.5 days.[56]

3. Lethality. Without treatment, tularemia is modeled with a case fatality rate of 75%, and $p_{f\text{-}Tul}(d_n) = 0.75*p_{E\text{-}Tul}(d_n)$. With treatment, all tularemia cases are expected to survive, and $p_{f\text{-}Tul}(d_n) = 0$.

4. Injury profile. Without treatment, distinct injury profiles exist for survivors and non-survivors of tularemia. Each injury profile characterizes the symptomatic period of illness and divides this period into two (for non-survivors) or three (for survivors) distinct stages. With treatment, all individuals ill with tularemia are expected to survive, and the disease is characterized by a single injury profile, divided into two distinct stages. The signs and symptoms characterizing each stage as well as the corresponding sign/symptom severity level for each stage

54 George H. Anno and Arthur P. Deverill, *Consequence Analytic Tools for NBC Operations Volume 1: Biological Agent Effects and Degraded Personnel Performance for Tularemia, Staphylococcal Enterotoxin B (SEB) and Q-Fever*, Defense Special Weapons Agency Report DSWA-TR-97-61-V1, October 1998.

55 Ibid.

56 Ibid.

are described in Tables C-xx through C-xx.[57] The duration of each stage is determined by the "duration of illness" models discussed in the following section.

**Table 82. Untreated Tularemia Survivor Injury Profile**

| | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|
| Signs and Symptoms (S/S) | High fever, headache, chills, sore throat, myalgia, chest pain. | Stage 1 S/S plus mild pneumonia. | Malaise, severe weakness. |
| S/S Severity | 3 (Severe) | 3 (Severe) | 2 (Moderate) |
| Outlook | Individual will progress to Stage 2. | Individual will progress to Stage 3. | Individual will likely recover. |

**Table 83. Untreated Tularemia Non-Survivor Injury Profile**

| | Stage 1 | Stage 2 |
|---|---|---|
| Signs and Symptoms (S/S) | High fever, headache, chills, sore throat, myalgia, chest pain. | Stage 1 S/S plus severe pneumonia, respiratory distress. |
| S/S Severity | 3 (Severe) | 4 (Very Severe) |
| Outlook | Individual will progress to Stage 2. | Individual will likely die without treatment. |

**Table 84. Treated Tularemia Survivor Injury Profile**

| | Stage 1 | Stage 2 |
|---|---|---|
| Signs and Symptoms (S/S) | High fever, headache, chills, sore throat, myalgia, chest pain. | Cessation of fever and resolution of symptoms. |
| S/S Severity | 3 (Severe) | 2 (Moderate) |
| Outlook | Individual will progress to Stage 2. | Individual will return to duty. |

5. Duration of illness.

a. For untreated survivors, the duration of illness for each stage of illness is modeled as a constant, such that

[57] Derived from descriptions found in Samuel Saslaw et al., "Tularemia Vaccine Study II. Respiratory Challenge," *Archives of Internal Medicine* 107 (1961): 702–14; Fred R. McCrumb Jr., "Aerosol Infection of Man with *Pasteurella tularensis*," *Bacteriological Review* 25 (1961): 262–67; and Byron M. Stuart and Roscoe L. Pullen, "Tularemic Pneumonia: Review of American Literature and Report of 15 Additional Cases," *American Journal of Medical Science* 210 (1945): 223–36.

$$F_{\text{Stg1-Tul}_S}(t_{\text{Stg1}}) = 1, \text{ for } t_{\text{Stg1}} \geq 12 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg1-Tul}_S}$ is the cumulative fraction of survivors with tularemia who have completed Stage 1 and entered Stage 2 of the disease,

$t_{\text{Stg1}}$ is the time since completing the incubation period [days],

$$F_{\text{Stg2-Tul}_S}(t_{\text{Stg2}}) = 1, \text{ for } t_{\text{Stg2}} \geq 28 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg2-Tul}_S}$ is the cumulative fraction of survivors with tularemia who have completed Stage 2 and entered Stage 3 of the disease,

$t_{\text{Stg2}}$ is the time since completing Stage 1 [days], and

$$F_{\text{Stg3-Tul}_S}(t_{\text{Stg3}}) = 1, \text{ for } t_{\text{Stg3}} \geq 84 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg3-Tul}_S}$ is the cumulative fraction of survivors with tularemia who have completed Stage 3 and recovered from the disease, and

$t_{\text{Stg3}}$ is the time since completing Stage 2 [days].[58]

b. For untreated non-survivors, the duration of illness for each stage of illness is similarly modeled as a constant, such that

$$F_{\text{Stg1-Tul}_{N\text{-}S}}(t_{\text{Stg1}}) = 1, \text{ for } t_{\text{Stg1}} \geq 9 \text{ days}$$

$$\text{else} = 0$$

where:

[58] Derived from data in Stuart and Pullen, "Tularemic Pneumonia," 233.

$F_{\text{Stg1-Tul}_{\text{N-S}}}$ is the cumulative fraction of non-survivors with tularemia who have completed Stage 1 and entered Stage 2 of the disease,

$t_{\text{Stg1}}$ is the time since completing the incubation period [days], and

$$F_{\text{Stg2-Tul}_{\text{N-S}}}(t_{\text{Stg2}}) = 1, \text{for } t_{\text{Stg2}} \geq 6 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg2-Tul}_{\text{N-S}}}$ is the cumulative fraction of non-survivors with tularemia who have completed Stage 2 and died from the disease,

$t_{\text{Stg2}}$ is the time since completing Stage 1 [days].[59]

c. For treated survivors, the duration of illness for each stage of illness is modeled as a constant, such that

$$F_{\text{Stg1-Tul}_{\text{S}}}(t_{\text{Stg1}}) = 1, \text{for } t_{\text{Stg1}} \geq 4 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg1-Tul}_{\text{S}}}$ is the cumulative fraction of survivors with tularemia who have completed Stage 1 and entered Stage 2 of the disease,

$t_{\text{Stg1}}$ is the time since completing the incubation period [days],

$$F_{\text{Stg2-Tul}_{\text{S}}}(t_{\text{Stg2}}) = 1, \text{for } t_{\text{Stg2}} \geq 6 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg2-Tul}_{\text{S}}}$ is the cumulative fraction of survivors with tularemia who have completed Stage 2 and returned to duty, and

$t_{\text{Stg2}}$ is the time since completing Stage 1 [days].

[59] Ibid.

## L. Pneumonic Plague Model Parameters (Section C134)

With the inclusion of non-contagious biological agent parameters for the five additional biological agents provided above, the section on Pneumonic Plague Model Parameters is renumbered as Section C134.

### 1. Modifications

The paragraph now renumbered as C134.2 should be modified to read:

2. Injury profile. Without treatment, the model assumes that pneumonic plague lethality is 100%; consequently, there is only one untreated plague injury profile, for non-survivors. The profile characterizes the symptomatic period of illness and divides this period into two stages. With treatment, individuals may or may not survive, as a function of when treatment is initiated. For treated non-survivors, the injury profile is the same as it is for untreated non-survivors. A separate injury profile characterizes the progression of injury for treated survivors. The signs and symptoms characterizing each stage as well as the corresponding sign/symptom severity level for each stage are described in Table C-xx.[60]

Table C-53, Plague Non-survivor Injury Profile, should be replaced with the following table:

**Table 85. Treated and Untreated Pneumonic Plague Injury Profile**

| | Stage 1 | Stage 2 (treated and untreated non-survivors) | Stage 2 (treated survivors) |
|---|---|---|---|
| Signs and Symptoms (S/S) | Severe headache, chills, nausea and vomiting, vertigo and general malaise, increased respiration and heart rates; steady rise in temperature; dry cough. | Progressively more productive cough, eventually producing copious amounts of bloody sputum; increased respiratory rate; dyspnea; high fever; exhaustion; weak pulse; cyanosis; frequent ataxia; confusion and disorientation; delirium; coma; eventual circulatory collapse or respiratory failure. | Cessation of symptoms and return to normal body temperature. |
| S/S Severity | 2 (Moderate) | 4 (Very Severe) | 2 (Moderate) |
| Outlook | Individual will progress to Stage 2, if treated in Stage 1 will survive, otherwise will not survive. | Individual will die. | Individual will return to duty. |

[60] Kool, "Risk of Person-to-Person Transmission"; R. D. Perry and J. D. Fetherston, "*Yersinia pestis*–Etiologic Agent of Plague," *Clinical Microbiology Reviews* 10, no. 1 (January 1997): 35–66; and Lien-Teh, *Treatise on Pneumonic Plague*.

**2. Additions**

The following text should be added as paragraph C134.4:

4. Duration of Illness. The parameters used to describe the duration of illness for untreated pneumonic plague in its various stages are among the inputs to the SEIRP model used to estimate contagious biological agent human response. These parameters are provided in Table A-47, Recommended Plague Model Parameters. When considering treatment, individuals are removed from the SEIRP model at the time they become WIA, and estimation of their subsequent disposition follows the methodology used to estimate non-contagious biological casualties from the same point in time. The relevant submodels are those for lethality, described in Annex A, and duration of illness, provided below.

a. Treated survivors. If the WIA criterion is set at WIA(1) or WIA(2), individuals ill with pneumonic plague are removed from the SEIRP model and are assumed to begin treatment at the start of Stage 1 of illness. Treatment is assumed to begin promptly upon entry into the medical system, within 24 hours of the onset of symptoms. Following the model for lethality with treatment, all casualties are expected to survive. For treated survivors, the duration of each stage of illness is modeled as a constant, such that

$$F_{\text{Stg1-Plg}_S}(t_{\text{Stg1}}) = 1, \text{ for } t_{\text{Stg1}} \geq 1 \text{ day}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg1-Plg}_S}$ is the cumulative fraction of survivors with pneumonic plague who have completed Stage 1 and entered Stage 2 of the disease,

$t_{\text{Stg1}}$ is the time since completing the incubation period [days], and

$$F_{\text{Stg2-Plg}_S}(t_{\text{Stg2}}) = 1, \text{ for } t_{\text{Stg2}} \geq 10 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg2-Plg}_S}$ is the cumulative fraction of survivors with pneumonic plague who have completed Stage 2 and returned to duty.

b. Treated non-survivors. If the WIA criterion is set at WIA(3), or if there is an expected delay in the initiation of treatment of greater than 24 hours after the onset of Stage 1, individuals ill with pneumonic plague are removed from the SEIRP model and are assumed to begin treatment during Stage 2 of illness. Following the model for lethality with treatment, all casualties are expected to become fatalities. For treated non-survivors, the duration of each stage

of illness is expected to be the same as that for untreated non-survivors. Using the pneumonic plague parameters from the SEIRP model, these are constants, such that

$$F_{\text{Stg1-Plg}_{\text{N-S}}}(t_{\text{Stg1}}) = 1, \text{ for } t_{\text{Stg1}} \geq 1 \text{ day}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg1-Plg}_{\text{N-S}}}$ is the cumulative fraction of non-survivors with pneumonic plague who have completed Stage 1 and entered Stage 2 of the disease,

$t_{\text{Stg1}}$ is the time since completing the incubation period [days], and

$$F_{\text{Stg2-Plg}_{\text{N-S}}}(t_{\text{Stg2}}) = 1, \text{ for } t_{\text{Stg2}} \geq 1.5 \text{ days}$$

$$\text{else} = 0$$

where:

$F_{\text{Stg2-Plg}_{\text{N-S}}}$ is the cumulative fraction of non-survivors with pneumonic plague who have completed Stage 2 and died from the disease,

$t_{\text{Stg2}}$ is the time since completing Stage 1 [days].

# 7. *AMedP-8(C)* Annex E Addenda

This chapter presents the addenda to *AMedP-8(C)* Annex E, specifically the references to be added for the new agents. To remain consistent with the current organization of this annex, the agent-specific reference sections should be arranged alphabetically in Annex E following the NATO References and the General References. The new order should be as follows:

E101 NATO References

E102 General References

E103 Anthrax References

E104 Blast References

E105 Botulism References

E106 Brucellosis References

E107 GB/VX References

E108 Glanders References

E109 HD References

E110 Plague References

E111 Q Fever References

E112 Radiation References

E113 Radiological References

E114 SEB References

E115 Smallpox References

E116 Thermal References

E117 Tularemia References

E118 VEE References

The agent-specific reference sections to be added to Annex E are below, as well as one specific reference to be added to Section E102, “General References.”

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# Appendix A
# Illustrations

## Figures

## Tables

# Appendix B
# References

In addition to the agent-specific references to be added to *AMedP-8(C)* (previously identified in Chapter 7), the following publications were referenced in the production of this document.


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# Appendix C
# Abbreviations

| | |
|---|---|
| AMedP-8 | Allied Medical Publication 8 |
| CBRE | Chemical, Biological, Radiological, Explosive |
| CBRN | Chemical, Biological, Radiological, Nuclear |
| CDF | Cumulative Distribution Function |
| CFU | Colony Forming Unit |
| CRN | Chemical, Radiological, and Nuclear |
| DOW | Died of Wounds |
| ED | Effective Dose |
| GI | Gastrointestinal |
| ID | Infectious Dose |
| IDA | Institute for Defense Analyses |
| NATO | North Atlantic Treaty Organization |
| SEB | Staphylococcal Enterotoxin B |
| VEE | Venezuelan Equine Encephalitis |
| WIA | Wounded in Action |

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The North Atlantic Treaty Organization (NATO) *Allied Medical Publication 8, NATO Planning Guide for the Estimation of CBRN Casualties*, referred to as (*AMedP-8(C)*), describes a methodology for estimating casualties resulting from chemical, biological, radiological, or nuclear (CBRN) attacks on military populations. In anticipation of a future expansion of the scope of *AMedP-8(C)*, the Institute for Defense Analyses (IDA) has recently revised the methodology to account for care provided to patients entering the medical system. Incorporating medical care parameters into the published NATO guide will require substantial changes to several chapters of the publication, as well as three of its annexes. This document presents the text, tables, and figures that will need to be added to *AMedP-8(C)* if medical care is integrated into the document. Each chapter of this document contains the addenda to one chapter or annex in *AMedP-8(C)*, and sections are written to be consistent with the existing contents of the NATO document.

**15. SUBJECT TERMS**

CBRN, Medical, NATO Medical Doctrine, AJMedP-7

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